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RESEARCH MEMORANDUM

A WIND-TUNNEL INVESTIGATION AT HIGH SUBSONIC SPEEDS OF THE LATERAL CONTROL CHARACTERISTICS OF VARIOUS PLAIN SPOILER CONFIGURATIONS ON A 3-PERCENT-THICK 60° DELTA WING

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RESEARCH MEMORANDUM

A WIND-TUNNEL INVESTIGATION AT HIGH SUBSONIC SPEEDS OF THE LATERAL CONTROL CHARACTERISTICS OF VARIOUS PLAIN SPOILER CONFIGURATIONS ON A 3-PERCENT-THICK 60° DELTA WING

By Harleth G. Wiley

SUMMARY

An investigation was made in the Langley high-speed 7- by 10-foot tunnel to determine the lateral control characteristics at high subsonic speeds of various plain spoiler configurations on a thin 60° delta wing. Investigated were the effects of spoiler projection, span, and spanwise and chordwise location. The delta wing had an NACA 65A003 airfoil parallel to free stream, a leading-edge sweep of 60°, and an aspect ratio, based on the theoretical tip span, of 2.31. Tests were made at 0° angle of sideslip through an angle-of-attack range of -2° to about 24° and over a Mach number range of 0.60 to 0.94. Spoiler deflections investigated were -1.0 to -9.5 percent mean aerodynamic chord.

Analysis of rolling-moment results indicated that favorable rolling moments can be obtained up to an angle of attack of 24° for a plain spoiler extending from the fuselage to 67 percent local-wing semispan and located at or behind the 85-percent wing-root-chord station. For spoilers located in a region of favorable spoiler effectiveness, the rolling moment produced increased with rearward movement of chordwise position, increase of spoiler span, and increase of projection. Partial-span spoilers, when located outboard on the wing, provided greater incremental rolling moment at low angles of attack than when located at inboard or midspan positions, but, at the higher angles of attack, the reverse was true. The variation of rolling moment with Mach number was minor but was somewhat dependent upon chordwise location of the spoiler.

INTRODUCTION

The present investigation is a continuation of a program conducted by the National Advisory Committee for Aeronautics to determine the

applicability of spoilers as lateral-control devices on thin delta wings (refs. 1 and 2). The present investigation was made in the Langley high-speed 7- by 10-foot tunnel to determine the lateral control characteristics at high subsonic speeds of various plain spoiler configurations on a thin 60° delta wing with rounded tips. The investigation covered the effects of spoiler projection, span, and of various spoiler wing-span and wing-chord locations. Spoiler projections tested varied from -1.0 to -9.5 percent wing mean aerodynamic chord. Tests were made at 0° angle of sideslip through a nominal angle-of-attack range of -2° to 24° and over a Mach number range of 0.60 to 0.94.

COEFFICIENTS AND SYMBOLS

The results of the tests are presented as standard NACA coefficients of forces and moments about the stability axes as presented in figure 1. All coefficients and constants are based on the consideration that the wing extends to the theoretical tip (fig. 2). Coefficients and symbols used herein are defined as follows:

C_L lift coefficient, Lift/qS

C_D drag coefficient, Drag/qS

C_m pitching-moment coefficient about $0.25\bar{c}$, Pitching moment/$qS\bar{c}$

C_l rolling-moment coefficient, Rolling moment/qSb

C_n yawing-moment coefficient, Yawing moment/qSb

C_Y lateral-force coefficient, Lateral force/qS

ΔC_L incremental lift coefficient (C_L of wing with spoiler less C_L of wing alone)

ΔC_D incremental drag coefficient (C_D of wing with spoiler less C_D of wing alone)

ΔC_m incremental pitching-moment coefficient (C_m of wing with spoiler less C_m of wing alone)

ΔC_l incremental rolling-moment coefficient (C_l of wing with spoiler less C_l of wing alone)

ΔC_n — incremental yawing-moment coefficient (C_n of wing with spoiler less C_n of wing alone)

ΔC_Y — incremental lateral-force coefficient (C_Y of wing with spoiler less C_Y of wing alone)

S — wing area, sq ft

b — wing span, ft

b_l — local wing span, ft

c — local wing chord, ft

c_r — wing-root chord, 1.974 ft

$\bar{c}$ — mean aerodynamic chord of wing, $\frac{2}{S}\int_0^{b/2} c^2 dy$, ft

y — spanwise distance normal to plane of symmetry, ft

y_i — distance from plane of symmetry to inboard end of spoiler, ft

y_o — distance from plane of symmetry to outboard end of spoiler, ft

b_s — spoiler span, $y_o - y_i$, ft

c_s — chordwise location of spoiler on wing measured from wing leading edge along root chord, ft

ρ — mass density of air, slugs/cu ft

V — free-stream velocity, ft/sec

q — free-stream dynamic pressure, $\frac{\rho V^2}{2}$, lb/sq ft

M — Mach number

R — Reynolds number of wing based on $\bar{c}$

α — angle of attack of wing, deg

δ_s — spoiler projection, negative when projected above upper surface of wing, percent $\bar{c}$

MODEL AND APPARATUS

The basic wing-fuselage combination used in this investigation is the same as that used in reference 3. Dimensional characteristics of the wing and fuselage are given in figure 2. The wing had a leading-edge sweep of 60°, an aspect ratio, based on the wing span extending to the theoretical tip, of 2.31, an NACA 65A003 airfoil section parallel to free stream, and was built of aluminum alloy. For practical considerations the wing tips were rounded as shown in figure 2.

Dimensions and locations of spoilers tested are presented in figure 3. Spoilers 1 to 4 were of constant local span extending from the fuselage side to $0.67b_l/2$ with various chordwise locations ($0.60c_r$, $0.85c_r$, $0.93c_r$, and $1.00c_r$). Spoilers 5 to 8 had a constant wing-chord location of $0.85c_r$. Spoiler 5 extended from the fuselage to $0.33b_l/2$; spoilers 6 and 7 extended from $0.33b_l/2$ to $0.67b_l/2$ and from $0.67b_l/2$ to $1.00b_l/2$, respectively; and spoiler 8 extended from the fuselage to $1.00b_l/2$. All spoilers were made of 1/8-inch-thick aluminum angle and were attached to the upper surface of the left wing with screws. (See fig. 3.)

The model was tested on the sting support of the Langley high-speed 7- by 10-foot tunnel and was mounted on a six-component electrical strain-gage balance housed within the fuselage. Aerodynamic forces and moments were measured on calibrated recording potentiometers.

TESTS AND CORRECTIONS

The tests were made in the Langley high-speed 7- by 10-foot tunnel over a Mach number range of 0.60 to 0.94 at 0° angle of sideslip and over a nominal angle-of-attack range of -2° to 24°. Spoilers 1, 2, and 3 were tested at deflections varying from $-0.010\bar{c}$ to $-0.095\bar{c}$ and spoiler 4 was tested at deflections of $-0.010\bar{c}$ to $-0.050\bar{c}$. Spoilers 5 to 8 were tested at a constant deflection of $-0.050\bar{c}$. Average Reynolds number for the tests (based on the mean aerodynamic chord of the wing) varied with Mach number from about 4.5×10^6 to 5.3×10^6 (fig. 4).

Tunnel-blocking corrections, based on the velocity-ratio method of reference 4, were applied to the data. Jet-boundary corrections, which were applied to the angle of attack and drag, were determined from reference 5. Drag data are presented with no base pressure adjustments applied to account for the differences in pressure at the base of the model and that of static free stream.

The angles of attack were corrected for deflection of the sting-support system under load. No corrections were applied to the data of the present paper to account for aeroelastic deflection of the model wings under load.

RESULTS AND DISCUSSION

All aerodynamic coefficients of this paper are based on the assumption that the wing span extends to the theoretical tip.

The aerodynamic characteristics of the plain 60° delta wing are presented in figure 5 and table I. (The wing-fuselage model is the same as that tested and presented in reference 3.) The variations of incremental rolling-moment coefficient ΔC_l with angle of attack at various Mach numbers and spoiler deflections are presented in figures 6 to 10 for all spoilers tested. All other incremental aerodynamic characteristics, ΔC_L, ΔC_D, ΔC_m, ΔC_n, and ΔC_Y, as well as ΔC_l, are presented in tables II to IX. The discussion of the present paper will be confined to the rolling-moment characteristics of the various spoiler configurations as installed on the wing. (For these tests, with the spoilers installed on the left wing, negative values of ΔC_l are favorable in that the negative sign indicates rolling moment in the desired direction.)

Effects of Angle of Attack

For all spoiler configurations at all projections and Mach numbers investigated, incremental rolling-moment coefficient ΔC_l increased negatively or remained generally constant with increase in angle of attack α up to angles of attack of at least 8°, and generally decreased (increased positively) at the higher angles of attack (figs. 6 to 10). At an angle of attack of about 12°, an abrupt "break" in the curve of the variation of ΔC_l with α occurred for several spoiler configurations at various Mach numbers. The break is similar to a nonlinearity obtained with this type spoiler on a swept wing and is attributed to wing-leading-edge flow separation as shown in reference 6.

Effects of Spoiler Chordwise Location

Representative variations of ΔC_l with chordwise location at various deflections for spoilers extending from the fuselage to $0.67b_l/2$ are presented in figure 11 for $\alpha = 0^\circ$ and 8.1°, and Mach numbers of 0.60

and 0.90. For spoiler chordwise locations and deflections which produce favorable rolling moments at $\alpha = 0^\circ$ (figs. 6 to 9), the negative value of ΔC_l increased linearly with rearward movement of spoiler positions at $M = 0.60$ and 0.90. (At $\alpha = 0^\circ$, the linear portion of the curves was extrapolated to the line of no-roll effectiveness ($\Delta C_l = 0$), to indicate the maximum forward spoiler location which probably will produce roll at each projection.) As indicated by the intersection of the extrapolated curves (dashed line), with the line of no-roll effectiveness at $M = 0.60$ (fig. 11), a spoiler extending from the fuselage to $0.67b_l/2$ will provide favorable roll at projections of $-0.010\bar{c}$ and $-0.095\bar{c}$ if located rearward of $0.88c_r$ and $0.66c_r$, respectively. At $M = 0.90$, it is apparent that favorable roll may be obtained for a specific deflection at spoiler locations somewhat more forward than for $M = 0.60$. (The relation between control deflection and chordwise location in the determination of regions of favorable control effectiveness is also shown in reference 7 for split flaps on a 48° delta wing.)

Effects of Spoiler Span and Spanwise Location

Presented in figure 12 is the variation at $\alpha = 0^\circ$ of ΔC_l with spoiler span for $-0.050\bar{c}$ projection spoilers located at $0.85c_r$, and extending from the fuselage to $0.33b_l/2$, $0.67b_l/2$, and $1.00b_l/2$ (spoilers 5, 2, and 8, respectively). At $M = 0.60$ and $M = 0.90$, the negative increase of ΔC_l with increase in spoiler span was generally linear (fig. 12).

In order to determine the individual contributions to ΔC_l of various span segments of a complete span spoiler of $-0.050\bar{c}$ projection, spoiler 8 was segmented and tested as spoilers 5, 6, and 7, with spans of $0.13b_l/2$, $0.33b_l/2$, and $0.33b_l/2$, respectively (fig. 10). The partial-span spoiler segment, when located in the outboard position on the wing, (spoiler 7), provided somewhat more linear variations of ΔC_l with α at low Mach numbers than when located at the midspan and inboard positions (spoilers 5 and 6, respectively). The outboard segment (spoiler 7) provided greater negative values of ΔC_l at low angles of attack than did the inboard and midpoint segments (spoilers 5 and 6), but for the higher angle-of-attack ranges the reverse was true. This trend is the same as that obtained at low speeds in reference 1. The incremental contributions at $\alpha = 0^\circ$ of ΔC_l for spoilers 5, 6, and 7 were added to simulate the characteristics of spoilers 2 and 8, respectively, and the results are plotted with flagged symbols on figure 12. At $M = 0.60$, the added incremental contributions of spoilers 5, 6, and 7 were slightly less than the values of ΔC_l exhibited for complete spoilers 2 and 8,

a condition opposite to that shown in reference 1. At $M = 0.90$, the total contributions of the spoiler segments were greater than the values of ΔC_l for the complete spoilers (fig. 12).

Effects of Spoiler Projection

The data of figures 6 to 9 have been cross-plotted in figure 13 to show the effects of spoiler projection on ΔC_l at $\alpha = 0^\circ$ and 8.1° and $M = 0.60$ and 0.90 for a spoiler extending from the fuselage to $0.67b_l/2$ at wing-chord locations of $0.60c_r$, $0.85c_r$, $0.93c_r$, and $1.00c_r$, respectively. Favorable rolling-moment coefficients were produced throughout the spoiler-deflection range at $\alpha = 0^\circ$ at $M = 0.60$ and 0.90 only for spoilers located at $0.93c_r$ and $1.00c_r$ (spoilers 3 and 4). For a spoiler location of $0.85c_r$, (spoiler 2), favorable values of ΔC_l were obtained at $M = 0.60$ only for projections above about $-0.010\bar{c}$. Spoiler 1, located at $0.60c_r$, produced generally unfavorable values of ΔC_l throughout the deflection range at $\alpha = 0^\circ$ at both Mach numbers (fig. 13). (The unfavorable values of ΔC_l at chordwise locations of $0.60c_r$ probably result from the reattachment of flow rearward of the spoiler as indicated in reference 8. Unpublished data show that incorporation of a slot behind the spoiler aids in preventing flow reattachment, thereby improving the rolling characteristics of spoilers at such locations.) At an angle of attack of 8.1° and Mach numbers of 0.60 and 0.90, favorable rolling moments were produced throughout the deflection range at all wing-chord locations. (The increase in favorable effectiveness with increase in angle of attack for spoilers located in forward positions is also shown in reference 1.)

In the range of favorable rolling effectiveness at $\alpha = 0^\circ$ and 8.1° and Mach numbers of 0.60 and 0.90, the value of ΔC_l increased negatively with spoiler projection. At the higher deflections there was a general decrease in the variation of ΔC_l with spoiler projection, figure 13.

Effects of Mach Number

The variation of ΔC_l with Mach number for spoilers extending from the fuselage to $0.67b_l/2$ and with wing-chord locations of $0.85c_r$, $0.93c_r$, and $1.00c_r$, is presented in figure 14 at a deflection of $-0.050\bar{c}$ for $\alpha = 0^\circ$ and 8.1°. At $\alpha = 0^\circ$, the variation of ΔC_l with Mach number varied from a slight linear negative increase throughout the Mach number range for a spoiler located at $0.85c_r$ to a linear decrease of ΔC_l with Mach number for a spoiler located at $1.00c_r$. The maximum variation of

ΔC_l with Mach number was about 20 percent. (Similar trends were obtained for spoilers located on the swept wing of reference 9.) At $\alpha = 8.1^{\circ}$, values of ΔC_l remained generally constant throughout the Mach number range for a spoiler located at $0.93c_r$ and decreased negatively for spoilers located at $0.85c_r$ and $1.00c_r$.

SUMMARY OF RESULTS

From an investigation to determine the lateral control characteristics of various spoilers on a thin 60° delta wing with rounded tips at high subsonic speeds, the following conclusions may be made:

1. Favorable rolling moments were obtained for a spoiler extending from the fuselage to 67-percent local-wing semispan and located at or behind the 85-percent wing-root-chord station and rolling effectiveness was linearly increased as the spoiler position was moved progressively rearward.

2. At Mach numbers of 0.60 and 0.90, for a spoiler located at 85 percent root chord and deflected -5.0 percent mean aerodynamic chord, rolling effectiveness increased linearly with outward increase of spoiler span.

3. Partial-span spoiler segments of -5.0-percent projection and 85-percent chordwise location, when located outboard on the wing, provided greater values of incremental rolling-moment coefficient at low angles of attack than when located in the midspan and inboard positions. At the higher angles of attack the reverse was true.

4. For spoilers located at positions which provided favorable rolling-moment coefficients throughout the angle-of-attack range, rolling-moment coefficient increased with increase in projection.

5. At angles of attack between 8° and 12°, an abrupt nonlinear variation of incremental rolling-moment coefficient with angle of attack generally occurred for most spoiler configurations.

6. The variation of incremental rolling-moment coefficient with Mach number was dependent upon spoiler chordwise location and the maximum variation was about 20 percent.

Langley Aeronautical Laboratory,
National Advisory Committee for Aeronautics,
Langley Field, Va., March 17, 1954.

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[redacted]

TABLE I.- AERODYNAMIC CHARACTERISTICS OF THE PLAIN 60° DELTA WING

[Note that the minus signs are given after the values]

M	α, deg	C_L	C_D	C_m	C_l	C_n	C_Y
.60	2.05-	.0810-	.0099	.0084	.0008-	.0001-	.0027
.60	.00-	.0026-	.0073	.0006-	.0010-	.0001-	.0025
.60	4.09	.1826	.0171	.0231-	.0014-	.0001-	.0029
.60	8.21	.4018	.0569	.0455-	.0018-	.0001-	.0048
.60	12.34	.6119	.1259	.0581-	.0023-	.0002	.0061
.60	16.29	.8002	.2220	.0988-	.0019-	.0000-	.0086
.60	20.35	.9603	.3398	.1230-	.0020-	.0000	.0105
.60	23.38	1.0564	.4379	.1406-	.0008-	.0006-	.0140
.80	2.06-	.0850-	.0091	.0102	.0007-	.0000-	.0025
.80	.00-	.0019-	.0066	.0009-	.0011-	.0001-	.0016
.80	4.13	.2042	.0181	.0287-	.0016-	.0001-	.0028
.80	8.28	.4384	.0615	.0590-	.0015-	.0002-	.0048
.80	12.43	.6237	.1303	.0699-	.0020-	.0000	.0068
.80	16.58	.8369	.2345	.0981-	.0017-	.0001-	.0083
.80	20.63	.9396	.3390	.1236-	.0024-	.0005-	.0097
.80	23.63	.9688	.4126	.1494-	.0001-	.0030-	.0100
.85	2.06-	.0897-	.0094	.0107	.0007-	.0000-	.0027
.85	.00-	.0003-	.0067	.0017-	.0009-	.0001-	.0015
.85	4.13	.2096	.0185	.0312-	.0014-	.0001-	.0032
.85	8.30	.4513	.0635	.0641-	.0017-	.0002-	.0047
.85	12.44-	.6183	.1299	.0700-	.0015-	.0002-	.0065
.85	16.57	.8319	.2351	.1087-	.0019-	.0001-	.0085
.85	20.62	.9142	.3323	.1288-	.0021-	.0012-	.0096

[redacted]

TABLE I.- Concluded

AERODYNAMIC CHARACTERISTICS OF THE PLAIN 60° DELTA WING

M	α, deg	C_L	C_D	C_m	C_l	C_n	C_Y
.90	2.06-	.0927-	.0093	.0120	.0008-	.0000-	.0025
.90	.00-	.0002-	.0066	.0011-	.0010-	.0002-	.0010
.90	4.13	.2233	.0196	.0360-	.0015-	.0001-	.0024
.90	8.29	.4772	.0673	.0793-	.0015-	.0002-	.0056
.90	12.44	.7189	.1502	.1238-	.0015-	.0007-	.0071
.90	16.57	.8449	.2416	.1255-	.0018-	.0003-	.0080
.94	2.07-	.0940-	.0096	.0140	.0007-	.0000-	.0020
.94	.00-	.0024	.0068	.0014-	.0011-	.0001-	.0010
.94	4.14	.2337	.0207	.0411-	.0015-	.0001-	.0024
.94	8.28	.4943	.0716	.0962-	.0016-	.0004-	.0045

TABLE II.- INCREMENTAL AERODYNAMIC CHARACTERISTICS OF 60° DELTA WING EQUIPPED WITH SPOILER 1

[Note that the minus signs are given after the values.

$c_s = 0.60c_r$; $y_i = 0.30b_l/2$; $y_o = 0.67b_l/2$]

(a) $\delta_s = -0.010\bar{c}$

M	α, deg	ΔC_L	ΔC_D	ΔC_m	ΔC_l	ΔC_n	ΔC_Y
.60	2.02-	.0265	.0008	.0019-	.0004	.0002-	.0065-
.60	.02	.0263	.0017	.0028-	.0001	.0002-	.0059-
.60	4.11	.0310	.0045	.0031-	.0003	.0003-	.0052-
.60	8.22	.0209	.0055	.0019-	.0002-	.0003-	.0059-
.60	12.34	.0078-	.0015	.0022	.0007-	.0002-	.0061-
.60	16.47	.0204	.0075	.0210	.0018-	.0005	.0071-
.60	20.56	.0206	.0085	.0261	.0022-	.0016	.0075-
.60	23.62	.0174	.0083	.0258	.0017-	.0020	.0081-
.80	2.03-	.0212	.0018	.0016-	.0004	.0002-	.0057-
.80	.00-	.0195	.0023	.0019-	.0005	.0002-	.0043-
.80	4.13	.0239	.0041	.0027-	.0004	.0001-	.0042-
.80	8.30	.0107	.0047	.0009	.0013-	.0001	.0045-
.80	12.43	.0188	.0065	.0053-	.0024	.0011-	.0049-
.80	16.57	.0144-	.0008-	.0049	.0044-	.0021	.0065-
.80	20.63	.0119-	.0021-	.0045	.0025-	.0036	.0083-
.80	23.60	.0178-	.0050-	.0011	.0019-	.0031	.0055-
.85	2.05-	.0229	.0019	.0007-	.0005	.0001-	.0061-
.85	.01	.0198	.0028	.0004-	.0001	.0002-	.0049-
.85	4.15	.0222	.0045	.0013-	.0004	.0001-	.0052-
.85	8.14	.1416-	.0173-	.0062-	.0016-	.0000-	.0060-
.85	12.46	.0678	.0159	.0252-	.0052-	.0011	.0057-
.85	16.58	.0040-	.0022	.0046	.0040-	.0022	.0075-
.85	20.64	.0045	.0048	.0029-	.0018-	.0031	.0065-
.90	2.04-	.0244	.0024	.0009-	.0005	.0002-	.0065-
.90	.01	.0212	.0032	.0013-	.0003	.0000-	.0049-
.90	4.17	.0167	.0048	.0005	.0000-	.0002-	.0046-
.90	8.30	.0003	.0047	.0047	.0034-	.0003	.0064-
.90	12.46	.0069-	.0027	.0117	.0049-	.0014	.0067-
.90	16.58	.0055	.0046	.0016-	.0025-	.0015	.0066-
.94	2.02-	.0346	.0031	.0012	.0003	.0001-	.0025-
.94	.02	.0271	.0048	.0036-	.0002	.0002-	.0010-
.94	4.13	.0305	.0077	.0154-	.0002	.0002-	.0009-
.94	8.28	.0143	.0067	.0067-	.0009-	.0001	.0007-

TABLE II.- Continued

INCREMENTAL AERODYNAMIC CHARACTERISTICS OF 60° DELTA WING EQUIPPED WITH SPOILER 1

$\left[c_s = 0.60c_r;\ y_i = 0.30b_l/2;\ y_o = 0.67b_l/2\right]$

(b) $\delta_s = -0.025\bar{c}$.

M	α, deg	ΔC_L	ΔC_D	ΔC_m	ΔC_l	ΔC_n	ΔC_Y
.60	2.03-	.0379	.0050	.0094-	.0015	.0001	.0022-
.60	.01	.0281	.0065	.0098-	.0013	.0000-	.0023-
.60	4.10	.0345	.0092	.0121-	.0009	.0000-	.0016-
.60	8.23	.0242	.0111	.0073-	.0021-	.0003	.0025-
.60	12.35	.0121	.0108	.0053-	.0021-	.0001-	.0021-
.60	16.45	.0031-	.0049	.0195	.0074-	.0034	.0030-
.60	20.54	.0062-	.0029	.0232	.0087-	.0069	.0054-
.60	23.60	.0103-	.0004-	.0244	.0063-	.0070	.0072-
.80	2.06-	.0315	.0055	.0128-	.0019	.0001	.0027-
.80	.00-	.0311	.0065	.0138-	.0017	.0001	.0018-
.80	4.12	.0251	.0084	.0157-	.0012	.0002	.0013-
.80	8.26	.0085	.0088	.0077-	.0022-	.0004	.0023-
.80	12.42	.0038	.0076	.0068-	.0016-	.0002-	.0034-
.80	16.55	.0373-	.0046-	.0015	.0096-	.0064	.0024-
.80	20.63	.0144-	.0017-	.0021	.0045-	.0056	.0056-
.80	23.62	.0125-	.0030-	.0046	.0052-	.0068	.0028-
.85	2.06-	.0337	.0055	.0144-	.0021	.0002	.0028-
.85	.01-	.0302	.0068	.0148-	.0016	.0001	.0016-
.85	4.11	.0228	.0085	.0167-	.0010	.0003	.0016-
.85	8.28	.0041	.0084	.0097-	.0021-	.0005	.0020-
.85	12.45	.0541	.0175	.0263-	.0082-	.0017	.0014-
.85	16.56	.0222-	.0002-	.0005	.0089-	.0052	.0046-
.85	20.63	.0071	.0070	.0055-	.0035-	.0043	.0037-
.90	2.06-	.0356	.0061	.0167-	.0022	.0003	.0026-
.90	.01-	.0279	.0075	.0172-	.0015	.0003	.0011-
.90	4.12	.0139	.0084	.0161-	.0002	.0007	.0007-
.90	8.28	.0018-	.0091	.0066-	.0035-	.0005	.0029-
.90	12.42	.0165-	.0060	.0033	.0081-	.0019	.0018-
.90	16.55	.0193-	.0015	.0010	.0079-	.0045	.0039-
.94	2.08-	.0298	.0066	.0171-	.0018	.0003	.0021-
.94	.01-	.0292	.0082	.0184-	.0010	.0002	.0014-
.94	4.11	.0110	.0096	.0201-	.0007-	.0007	.0011-
.94	8.26	.0021	.0110	.0098-	.0023-	.0003-	.0007-

TABLE II.- Continued

INCREMENTAL AERODYNAMIC CHARACTERISTICS OF 60° DELTA WING EQUIPPED WITH SPOILER 1

[$c_s = 0.60c_r$; $y_i = 0.30b_l/2$; $y_o = 0.67b_l/2$]

(c) $\delta_s = -0.050\bar{c}$

M	α, deg	ΔC_L	ΔC_D	ΔC_m	ΔC_l	ΔC_n	ΔC_Y
.60	2.04-	.0513	.0119	.0224-	.0041	.0006	.0056-
.60	.00-	.0430	.0141	.0241-	.0029	.0006	.0051-
.60	4.08	.0408	.0168	.0280-	.0024	.0007	.0044-
.60	8.20	.0218	.0185	.0238-	.0011-	.0011	.0047-
.60	12.33	.0098-	.0134	.0078-	.0074-	.0021	.0040-
.60	16.43	.0304-	.0051	.0181	.0112-	.0063	.0046-
.60	20.52	.0417-	.0033-	.0254	.0104-	.0092	.0064-
.60	23.59	.0231-	.0012-	.0253	.0076-	.0098	.0098-
.80	2.07-	.0349	.0129	.0270-	.0038	.0008	.0052-
.80	.03-	.0325	.0143	.0271-	.0032	.0008	.0044-
.80	4.08	.0074	.0148	.0252-	.0004	.0018	.0044-
.80	8.23	.0035-	.0152	.0208-	.0032-	.0017	.0050-
.80	12.40	.0081	.0153	.0197-	.0132-	.0052	.0037-
.80	16.53	.0537-	.0022-	.0009	.0129-	.0090	.0051-
.80	20.62	.0251-	.0016-	.0023	.0064-	.0078	.0060-
.80	23.65	.0003-	.0045	.0067	.0075-	.0110	.0041-
.85	2.09-	.0353	.0131	.0267-	.0035	.0009	.0056-
.85	.03-	.0269	.0145	.0256-	.0027	.0010	.0048-
.85	4.08	.0002	.0149	.0218-	.0004-	.0022	.0044-
.85	8.24	.0072-	.0145	.0201-	.0039-	.0018	.0050-
.85	12.41	.0312	.0201	.0300-	.0151-	.0048	.0039-
.85	16.55	.0354-	.0029	.0011-	.0126-	.0078	.0053-
.85	20.63	.0102	.0115	.0039-	.0070-	.0082	.0068-
.90	2.09-	.0342	.0137	.0261-	.0029	.0012	.0060-
.90	.04-	.0203	.0153	.0255-	.0017	.0014	.0052-
.90	4.08	.0177-	.0147	.0196-	.0019-	.0029	.0049-
.90	8.25	.0180-	.0142	.0140-	.0050-	.0017	.0057-
.90	12.42	.0474-	.0076	.0090	.0119-	.0033	.0050-
.90	16.54	.0326-	.0033	.0015-	.0105-	.0060	.0057-
.94	2.11-	.0123	.0157	.0205-	.0013	.0015	.0066-
.94	.05-	.0069	.0176	.0213-	.0001-	.0018	.0058-
.94	4.07	.0140-	.0171	.0224-	.0024-	.0032	.0056-
.94	8.22	.0100-	.0170	.0185-	.0010-	.0001	.0038-

TABLE II.- Concluded

INCREMENTAL AERODYNAMIC CHARACTERISTICS OF 60° DELTA WING EQUIPPED WITH SPOILER 1

$\left[c_s = 0.60c_r;\ y_1 = 0.30b_l/2;\ y_o = 0.67b_l/2\right]$

(d) $\delta_s = -0.095\bar{c}$.

M	α, deg	ΔC_L	ΔC_D	ΔC_m	ΔC_l	ΔC_n	ΔC_Y
.60	2.06-	.0590	.0216	.0399-	.0060	.0013	.0057-
.60	.03-	.0431	.0257	.0408-	.0045	.0013	.0065-
.60	4.05	.0232	.0285	.0389-	.0010	.0019	.0054-
.60	8.15	.0242-	.0264	.0299-	.0056-	.0053	.0046-
.60	12.28	.0398-	.0165	.0243-	.0113-	.0059	.0032-
.60	16.40	.0538-	.0059	.0126	.0156-	.0102	.0025-
.60	20.52	.0295-	.0022	.0128	.0095-	.0106	.0060-
.60	23.58	.0206-	.0029	.0186	.0085-	.0118	.0075-
.80	2.11-	.0250	.0261	.0369-	.0031	.0019	.0071-
.80	.06-	.0155	.0275	.0350-	.0018	.0022	.0062-
.80	4.04	.0215-	.0265	.0294-	.0020-	.0033	.0064-
.80	8.19	.0503-	.0196	.0231-	.0072-	.0055	.0051-
.80	12.34	.0256-	.0175	.0329-	.0171-	.0081	.0042-
.80	16.51	.0756-	.0008-	.0046-	.0157-	.0107	.0041-
.80	20.61	.0254-	.0002	.0038-	.0070-	.0097	.0062-
.80	23.64	.0015-	.0051	.0035	.0077-	.0108	.0006-
.85	2.12-	.0154	.0268	.0336-	.0021	.0022	.0073-
.85	.07-	.0018	.0282	.0318-	.0006	.0027	.0065-
.85	4.04	.0348-	.0269	.0262-	.0035-	.0038	.0072-
.85	8.19	.0572-	.0193	.0223-	.0075-	.0057	.0009-
.85	12.35	.0169-	.0186	.0365-	.0174-	.0083	.0005
.85	16.51	.0533-	.0058	.0092-	.0151-	.0102	.0044-
.85	20.63	.0032	.0113	.0042-	.0073-	.0089	.0050-
.90	2.13-	.0042	.0281	.0305-	.0010	.0025	.0081-
.90	.07-	.0061-	.0300	.0287-	.0009-	.0033	.0064-
.90	4.04	.0461-	.0274	.0236-	.0042-	.0042	.0063-
.90	8.17	.0768-	.0183	.0166-	.0084-	.0059	.0056-
.90	12.34	.0889-	.0074	.0052-	.0151-	.0079	.0043-
.90	16.50	.0614-	.0034	.0044-	.0136-	.0086	.0048-
.94	2.13-	.0237-	.0352	.0144-	.0014-	.0032	.0090-
.94	.07-	.0164-	.0368	.0230-	.0011-	.0033	.0073-
.94	4.03	.0382-	.0363	.0305-	.0022-	.0032	.0042-
.94	8.34	.0554-	.0242	.0495	.0054-	.0043	.0042-

TABLE III.- INCREMENTAL AERODYNAMIC CHARACTERISTICS OF 60° DELTA WING EQUIPPED WITH SPOILER 2

[Note that the minus signs are given after the values.

$c_s = 0.85c_r$; $y_i = 0.20b_l/2$; $y_o = 0.67b_l/2$]

(a) $\delta_s = -0.010\bar{c}$

M	α, deg	ΔC_L	ΔC_D	ΔC_m	ΔC_l	ΔC_n	ΔC_Y
.60	2.05-	.0116	.0027	.0074-	.0006	.0004-	.0033-
.60	.01-	.0018	.0033	.0074-	.0004	.0004-	.0027-
.60	4.09	.0088	.0038	.0064-	.0003-	.0004-	.0014-
.60	8.22	.0037	.0041	.0060-	.0003-	.0004-	.0014-
.60	12.34	.0108-	.0016	.0002-	.0024-	.0001	.0003-
.60	16.46	.0061	.0042	.0203	.0026-	.0007	.0013-
.60	20.57	.0094	.0054	.0278	.0028-	.0013	.0026-
.60	23.62	.0068	.0042	.0312	.0035-	.0022	.0052-
.80	2.07-	.0036-	.0034	.0050-	.0000-	.0003-	.0018-
.80	.01-	.0004-	.0034	.0046-	.0002-	.0003-	.0014-
.80	4.11	.0102-	.0026	.0027-	.0007-	.0003-	.0011-
.80	8.26	.0103-	.0022	.0017-	.0013-	.0001-	.0012-
.80	12.42	.0197-	.0007-	.0024	.0024-	.0003	.0016-
.80	16.56	.0151-	.0015-	.0029	.0030-	.0013	.0009-
.80	20.62	.0224-	.0047-	.0015	.0041-	.0051	.0058-
.80	23.61	.0139-	.0025-	.0019	.0038-	.0045	.0021-
.85	2.07-	.0017-	.0034	.0037-	.0001-	.0003-	.0026-
.85	.01-	.0063-	.0037	.0022-	.0005-	.0003-	.0018-
.85	4.13	.0081-	.0029	.0006-	.0013-	.0002-	.0023-
.85	8.28	.0084-	.0026	.0003-	.0014-	.0001-	.0019-
.85	12.44	.0100-	.0016	.0025	.0024-	.0003	.0018-
.85	16.58	.0045-	.0018	.0034	.0028-	.0012	.0016-
.85	20.61	.0053-	.0019	.0051-	.0052-	.0070	.0063-
.90	2.07-	.0057-	.0041	.0012-	.0005-	.0003-	.0025-
.90	.00-	.0059-	.0042	.0007-	.0011-	.0002-	.0014-
.90	4.13	.0130-	.0032	.0025	.0015-	.0002-	.0015-
.90	8.30	.0184-	.0019	.0067	.0020-	.0000-	.0031-
.90	12.45	.0411-	.0015-	.0261	.0110-	.0044	.0042-
.90	16.58	.0110-	.0002	.0017	.0025-	.0009	.0031-
.94	2.02-	.0044-	.0042	.0187	.0009-	.0003-	.0022-
.94	.01-	.0109-	.0044	.0010	.0013-	.0003-	.0022-
.94	4.01	.0248-	.0028	.0419-	.0014-	.0004-	.0013-
.94	8.27	.0113-	.0032	.0047	.0020-	.0001-	.0018-

TABLE III.- Continued

INCREMENTAL AERODYNAMIC CHARACTERISTICS OF 60° DELTA WING EQUIPPED WITH SPOILER 2

$\left[c_s = 0.85c_r;\ y_i = 0.20b_l/2;\ y_o = 0.67b_l/2\right]$

(b) $\delta_s = -0.025\bar{c}$.

M	α, deg	ΔC_L	ΔC_D	ΔC_m	ΔC_l	ΔC_n	ΔC_Y
.60	2.05-	.0153-	.0067	.0011-	.0022-	.0001-	.0042-
.60	.02-	.0250-	.0068	.0012-	.0024-	.0000-	.0043-
.60	4.08	.0300-	.0041	.0013	.0038-	.0008	.0035-
.60	8.19	.0278-	.0035	.0024-	.0052-	.0007	.0044-
.60	12.32	.0368-	.0005-	.0016-	.0054-	.0008	.0032-
.60	16.43	.0397-	.0066-	.0210	.0053-	.0019	.0028-
.60	20.55	.0051	.0062	.0259	.0053-	.0037	.0027-
.60	23.60	.0226-	.0056-	.0321	.0076-	.0065	.0051-
.80	2.08-	.0326-	.0086	.0052	.0037-	.0000	.0036-
.80	.02-	.0297-	.0079	.0048	.0036-	.0002	.0039-
.80	4.11	.0416-	.0048	.0073	.0047-	.0009	.0043-
.80	8.26	.0418-	.0029	.0095	.0072-	.0012	.0051-
.80	12.40	.0352-	.0001-	.0036	.0056-	.0014	.0028-
.80	16.56	.0312-	.0032-	.0047	.0079-	.0044	.0037-
.80	20.63	.0013-	.0042	.0001	.0058-	.0056	.0035-
.80	23.61	.0122-	.0011-	.0007	.0061-	.0069	.0007
.85	2.07-	.0224-	.0092	.0095	.0044-	.0001-	.0068-
.85	.01-	.0242-	.0089	.0085	.0040-	.0000-	.0054-
.85	4.13	.0295-	.0071	.0120	.0053-	.0009	.0057-
.85	8.29	.0376-	.0049	.0141	.0078-	.0015	.0050-
.85	12.45	.0258	.0131	.0100-	.0121-	.0029	.0044-
.85	16.58	.0016-	.0061	.0076	.0073-	.0034	.0049-
.85	20.65	.0244	.0148	.0002-	.0057-	.0062	.0069-
.90	2.06-	.0293-	.0104	.0125	.0039-	.0001-	.0084-
.90	.01-	.0270-	.0100	.0113	.0045-	.0003	.0063-
.90	4.13	.0359-	.0077	.0152	.0053-	.0009	.0066-
.90	8.30	.0483-	.0043	.0234	.0079-	.0015	.0080-
.90	12.47	.0400-	.0353-	.0288	.0134-	.0038	.0069-
.90	16.59	.0179	.0126	.0004	.0059-	.0023	.0051-
.94	2.06-	.0347-	.0114	.0154	.0046-	.0001-	.0089-
.94	.00-	.0296-	.0110	.0136	.0044-	.0002	.0072-
.94	4.13	.0435-	.0074	.0181	.0052-	.0008	.0079-
.94	8.30	.0381-	.0059	.0228	.0073-	.0013	.0076-

TABLE III.- Continued

INCREMENTAL AERODYNAMIC CHARACTERISTICS OF 60° DELTA WING EQUIPPED WITH SPOILER 2

$\left[c_s = 0.85c_r;\ y_i = 0.20b_l/2;\ y_o = 0.67b_l/2\right]$

(c) $\delta_s = -0.050\bar{c}$

M	α, deg	ΔC_L	ΔC_D	ΔC_m	ΔC_l	ΔC_n	ΔC_Y
.60	2.05-	.0341-	.0166	.0120	.0074-	.0000-	.0166-
.60	.02-	.0468-	.0160	.0109	.0077-	.0005	.0140-
.60	4.08	.0552-	.0120	.0158	.0098-	.0021	.0131-
.60	8.19	.0682-	.0075	.0186	.0133-	.0034	.0152-
.60	12.32	.0532-	.0030	.0092	.0109-	.0024	.0113-
.60	16.45	.0155-	.0075	.0273	.0112-	.0046	.0091-
.60	20.55	.0290-	.0016	.0346	.0104-	.0070	.0137-
.60	23.60	.0239-	.0011	.0357	.0132-	.0110	.0130-
.80	2.06-	.0519-	.0191	.0184	.0086-	.0004	.0129-
.80	.02-	.0559-	.0179	.0175	.0090-	.0008	.0124-
.80	4.10	.0798-	.0126	.0226	.0107-	.0024	.0122-
.80	8.25	.0852-	.0075	.0264	.0135-	.0035	.0136-
.80	12.41	.0455-	.0046	.0093	.0120-	.0034	.0101-
.80	16.54	.0673-	.0060-	.0137	.0120-	.0055	.0078-
.80	20.63	.0269-	.0010-	.0117	.0088-	.0096	.0106-
.80	23.65	.0132	.0115	.0056	.0099-	.0103	.0042-
.85	2.08-	.0604-	.0202	.0208	.0089-	.0006	.0134-
.85	.01-	.0611-	.0189	.0207	.0094-	.0010	.0129-
.85	4.12	.0789-	.0133	.0248	.0108-	.0023	.0127-
.85	8.28	.0830-	.0092	.0263	.0130-	.0037	.0129-
.85	12.43	.0084-	.0128	.0030-	.0150-	.0047	.0113-
.85	16.55	.0446-	.0007	.0120	.0118-	.0055	.0086-
.85	20.67	.0129	.0132	.0100	.0083-	.0084	.0094-
.90	2.08-	.0625-	.0212	.0217	.0092-	.0007	.0134-
.90	.01-	.0618-	.0206	.0212	.0093-	.0013	.0121-
.90	4.11	.0842-	.0139	.0254	.0103-	.0024	.0119-
.90	8.22	.1524-	.0002-	.0333	.0123-	.0036	.0138-
.90	12.43	.0860-	.0004-	.0311	.0156-	.0048	.0109-
.90	16.54	.0659-	.0065-	.0163	.0114-	.0051	.0083-
.94	2.13-	.0666-	.0230	.0022	.0097-	.0009	.0118-
.94	.04-	.0661-	.0208	.0101	.0093-	.0012	.0116-
.94	4.15	.0820-	.0153	.0362	.0100-	.0022	.0115-
.94	8.38	.0888-	.0096	.0759	.0109-	.0028	.0119-

TABLE III.- Concluded

INCREMENTAL AERODYNAMIC CHARACTERISTICS OF 60° DELTA WING EQUIPPED WITH SPOILER 2

$\left[c_s = 0.85c_r;\ y_i = 0.20b_l/2;\ y_o = 0.67b_l/2\right]$

(d) $\delta_s = -0.095\bar{c}$.

M	α, deg	ΔC_L	ΔC_D	ΔC_m	ΔC_l	ΔC_n	ΔC_Y
.60	2.07-	.0990-	.0379	.0246	.0133-	.0013	.0131-
.60	.03-	.0957-	.0363	.0246	.0140-	.0021	.0116-
.60	4.06	.1149-	.0277	.0288	.0160-	.0035	.0110-
.60	8.18	.1200-	.0194	.0310	.0187-	.0059	.0099-
.60	12.29	.1348-	.0050	.0304	.0190-	.0070	.0086-
.60	16.42	.1129-	.0018-	.0516	.0197-	.0094	.0052-
.60	20.53	.0982-	.0100-	.0569	.0182-	.0142	.0076-
.60	23.59	.0728-	.0048-	.0489	.0176-	.0164	.0075-
.80	1.92-	.0649	.0346	.0351	.0134-	.0016	.0107-
.80	.04	.0266-	.0386	.0325	.0143-	.0023	.0103-
.80	4.08	.1306-	.0300	.0340	.0163-	.0038	.0112-
.80	8.22	.1326-	.0182	.0321	.0169-	.0055	.0095-
.80	12.37	.1133-	.0072	.0233	.0201-	.0072	.0087-
.80	16.53	.1193-	.0049-	.0279	.0190-	.0097	.0048-
.80	20.63	.0590-	.0075-	.0209	.0131-	.0128	.0075-
.80	23.67	.0059	.0121	.0181	.0141-	.0160	.0019
.85	2.09-	.0981-	.0412	.0292	.0137-	.0015	.0120-
.85	.05-	.1073-	.0392	.0297	.0142-	.0024	.0106-
.85	4.09	.1340-	.0301	.0348	.0161-	.0037	.0114-
.85	8.24	.1332-	.0184	.0316	.0162-	.0054	.0092-
.85	12.39	.0663-	.0178	.0046	.0214-	.0078	.0080-
.85	16.54	.1056-	.0033-	.0287	.0186-	.0096	.0055-
.85	20.64	.0145-	.0091	.0114	.0131-	.0131	.0072-
.90	2.10-	.1048-	.0431	.0312	.0139-	.0017	.0118-
.90	.05-	.1138-	.0413	.0306	.0144-	.0025	.0101-
.90	4.09	.1391-	.0337	.0349	.0157-	.0034	.0101-
.90	8.25	.1393-	.0194	.0369	.0161-	.0052	.0092-
.90	12.41	.1400-	.0051	.0423	.0200-	.0077	.0084-
.90	16.55	.0805-	.0067	.0215	.0164-	.0071	.0036-
.94	2.09-	.1079-	.0467	.0363	.0140-	.0016	.0107-
.94	.04-	.1120-	.0466	.0332	.0131-	.0016	.0096-
.94	4.08	.1394-	.0377	.0350	.0141-	.0021	.0075-
.94	8.23	.1384-	.0243	.0383	.0133-	.0034	.0078-

TABLE IV.- INCREMENTAL AERODYNAMIC CHARACTERISTICS OF 60° DELTA WING EQUIPPED WITH SPOILER 3

[Note that the minus signs are given after the values.

$c_s = 0.93c_r$; $y_i = 0.18b_l/2$; $y_o = 0.67b_l/2$]

(a) $\delta_s = -0.010\bar{c}$

M	α, deg	ΔC_L	ΔC_D	ΔC_m	ΔC_l	ΔC_n	ΔC_Y
.60	2.02-	.0223	.0000-	.0052	.0022-	.0008-	.0089-
.60	.01	.0078	.0005	.0054	.0023-	.0007-	.0064-
.60	4.11	.0195	.0018	.0037	.0023-	.0004-	.0056-
.60	8.23	.0239	.0045	.0019	.0011-	.0004-	.0060-
.60	12.36	.0095	.0027	.0031	.0012-	.0004-	.0054-
.60	16.48	.0355	.0089	.0194	.0007-	.0002-	.0058-
.60	20.57	.0338	.0108	.0253	.0002-	.0001-	.0058-
.60	23.64	.0396	.0154	.0250	.0002-	.0002-	.0026-
.80	2.04-	.0025-	.0019	.0079	.0029-	.0007-	.0050-
.80	.02	.0023	.0017	.0083	.0030-	.0005-	.0045-
.80	4.15	.0037	.0020	.0073	.0028-	.0003-	.0043-
.80	8.30	.0010-	.0011	.0088	.0023-	.0001-	.0048-
.80	12.45	.0012-	.0006	.0058	.0018-	.0001-	.0047-
.80	16.87	.0311	.0076	.1261	.0019-	.0003	.0045-
.80	20.83	.0094	.0026	.0875	.0000-	.0005-	.0014-
.80	23.85	.0220	.0088	.1011	.0009-	.0009	.0006-
.85	2.04-	.0009	.0019	.0094	.0030-	.0006-	.0038-
.85	.02	.0009	.0020	.0104	.0033-	.0005-	.0042-
.85	4.15	.0010-	.0014	.0092	.0032-	.0001-	.0045-
.85	8.31	.0003	.0016	.0072	.0025-	.0000-	.0044-
.85	12.45	.0088-	.0008-	.0054	.0020-	.0000-	.0048-
.85	16.78	.0357	.0102	.0775	.0018-	.0001	.0040-
.85	20.64	.0207	.0103	.0069-	.0010-	.0007	.0018-
.90	2.04-	.0035	.0023	.0112	.0031-	.0007-	.0038-
.90	.02	.0008	.0023	.0106	.0036-	.0004-	.0036-
.90	4.17	.0061-	.0015	.0128	.0033-	.0001-	.0039-
.90	8.32	.0155-	.0001-	.0176	.0030-	.0000-	.0055-
.90	12.49	.0323-	.0038-	.0331	.0116-	.0031	.0050-
.90	16.58	.0002	.0003	.0033	.0013-	.0001	.0044-
.94	2.03-	.0057-	.0029	.0128	.0036-	.0007-	.0052-
.94	.03	.0017-	.0030	.0118	.0036-	.0005-	.0039-
.94	4.16	.0129	.0043	.0007-	.0033-	.0002-	.0036-
.94	8.30	.0030	.0021	.0079	.0027-	.0001	.0044-

TABLE IV.- Continued

INCREMENTAL AERODYNAMIC CHARACTERISTICS OF 60° DELTA WING EQUIPPED WITH SPOILER 3

$\left[c_s = 0.93c_r;\ y_i = 0.18b_l/2;\ y_o = 0.67b_l/2\right]$

(b) $\delta_s = -0.025\bar{c}$.

M	α, deg	ΔC_L	ΔC_D	ΔC_m	ΔC_l	ΔC_n	ΔC_Y
.60	2.04-	.0372-	.0083	.0190	.0066-	.0007-	.0090-
.60	.00-	.0448-	.0069	.0201	.0070-	.0004-	.0097-
.60	4.09	.0504-	.0028	.0209	.0077-	.0007	.0088-
.60	8.20	.0485-	.0005	.0183	.0077-	.0009	.0101-
.60	12.33	.0438-	.0030-	.0131	.0063-	.0008	.0086-
.60	16.45	.0286-	.0051-	.0319	.0049-	.0015	.0075-
.60	20.54	.0142-	.0019-	.0322	.0044-	.0022	.0079-
.60	23.62	.0214	.0123	.0256	.0027-	.0011	.0040-
.80	2.05-	.0503-	.0098	.0221	.0074-	.0007-	.0075-
.80	.02-	.0654-	.0080	.0226	.0077-	.0003-	.0075-
.80	4.13	.0531-	.0032	.0231	.0075-	.0007	.0070-
.80	8.28	.0503-	.0015	.0250	.0088-	.0012	.0084-
.80	12.42	.0500-	.0045-	.0168	.0061-	.0007	.0074-
.80	16.55	.0636-	.0141-	.0170	.0048-	.0016	.0058-
.80	20.63	.0198-	.0022-	.0048	.0022-	.0019	.0054-
.80	23.64	.0019-	.0035	.0032	.0010-	.0001	.0041-
.85	2.05-	.0436-	.0099	.0236	.0075-	.0007-	.0079-
.85	.01	.0439-	.0083	.0254	.0079-	.0003-	.0065-
.85	4.14	.0466-	.0044	.0243	.0080-	.0008	.0070-
.85	8.30	.0602-	.0004	.0274	.0079-	.0011	.0075-
.85	12.46	.0254-	.0009	.0148	.0077-	.0012	.0067-
.85	16.57	.0129-	.0011	.0036	.0040-	.0012	.0059-
.85	20.64	.0105	.0097	.0014-	.0027-	.0034	.0048-
.90	2.05-	.0465-	.0103	.0250	.0077-	.0007-	.0079-
.90	.01	.0485-	.0088	.0244	.0080-	.0003-	.0062-
.90	4.15	.0492-	.0042	.0262	.0077-	.0008	.0063-
.90	8.32	.0611-	.0008	.0363	.0080-	.0011	.0090-
.90	12.46	.1081-	.0153-	.0543	.0097-	.0023	.0076-
.90	16.05	.4333-	.1658-	.0297-	.0030-	.0002	.0078-
.94	2.04-	.0458-	.0104	.0253	.0078-	.0006-	.0073-
.94	.02	.0421-	.0098	.0241	.0074-	.0004-	.0060-
.94	4.15	.0471-	.0054	.0257	.0077-	.0006	.0056-
.94	8.29	.0453-	.0033	.0239	.0079-	.0010	.0071-

TABLE IV.- Continued

INCREMENTAL AERODYNAMIC CHARACTERISTICS OF 60° DELTA WING EQUIPPED WITH SPOILER 3

$\left[c_s = 0.93c_r;\ y_i = 0.18b_l/2;\ y_o = 0.67b_l/2\right]$

(c) $\delta_s = -0.050\bar{c}$

M	α, deg	ΔC_L	ΔC_D	ΔC_m	ΔC_l	ΔC_n	ΔC_Y
.60	2.06-	.0800-	.0221	.0306	.0122-	.0004-	.0083-
.60	.02-	.0881-	.0173	.0317	.0127-	.0000-	.0110-
.60	4.07	.0904-	.0112	.0328	.0135-	.0023	.0091-
.60	8.20	.0873-	.0073	.0338	.0152-	.0036	.0108-
.60	12.31	.0890-	.0048-	.0237	.0121-	.0026	.0077-
.60	16.44	.0566-	.0028-	.0439	.0111-	.0050	.0066-
.60	20.54	.0539-	.0059-	.0466	.0103-	.0065	.0088-
.60	23.60	.0358-	.0050-	.0392	.0105-	.0072	.0087-
.80	1.89-	.0816	.0177	.0435	.0127-	.0004-	.0091-
.80	.00-	.0860-	.0204	.0370	.0129-	.0001	.0088-
.80	4.13	.0916-	.0121	.0378	.0136-	.0021	.0087-
.80	8.27	.1007-	.0072	.0412	.0152-	.0028	.0106-
.80	12.42	.0717-	.0030	.0232	.0101-	.0037	.0082-
.80	16.57	.0582-	.0019-	.0207	.0103-	.0046	.0057-
.80	20.64	.0348-	.0013	.0111	.0063-	.0062	.0071-
.80	23.65	.0086	.0122	.0042	.0053-	.0033	.0039-
.85	2.06-	.0850-	.0233	.0388	.0129-	.0005-	.0114-
.85	.00-	.0860-	.0205	.0392	.0133-	.0002	.0083-
.85	4.14	.0883-	.0129	.0396	.0134-	.0022	.0089-
.85	8.29	.1003-	.0081	.0414	.0150-	.0029	.0111-
.85	12.44	.0166-	.0113	.0040	.0159-	.0040	.0076-
.85	16.57	.0445-	.0016	.0188	.0103-	.0045	.0072-
.85	20.63	.0044-	.0094	.0039	.0056-	.0058	.0073-
.90	2.05-	.0813-	.0240	.0390	.0134-	.0004-	.0113-
.90	.01	.0840-	.0221	.0387	.0138-	.0005	.0086-
.90	4.14	.0932-	.0138	.0399	.0135-	.0023	.0085-
.90	8.31	.1036-	.0092	.0483	.0152-	.0029	.0120-
.90	12.46	.1253-	.0074-	.0618	.0142-	.0036	.0097-
.90	16.57	.0410-	.0024	.0153	.0106-	.0045	.0063-
.94	2.04-	.0857-	.0252	.0420	.0134-	.0003-	.0109-
.94	.01	.0826-	.0237	.0390	.0126-	.0001	.0084-
.94	4.14	.0956-	.0147	.0429	.0129-	.0020	.0086-
.94	8.31	.0872-	.0121	.0466	.0145-	.0021	.0102-

TABLE IV.- Concluded

INCREMENTAL AERODYNAMIC CHARACTERISTICS OF 60° DELTA WING EQUIPPED WITH SPOILER 3

$\left[c_s = 0.93c_r;\ y_i = 0.18b_l/2;\ y_o = 0.67b_l/2\right]$

(d) $\delta_s = -0.095\bar{c}$.

M	α, deg	ΔC_L	ΔC_D	ΔC_m	ΔC_l	ΔC_n	ΔC_Y
.60	2.05-	.0958-	.0441	.0447	.0186-	.0005-	.0116-
.60	.02-	.1049-	.0401	.0458	.0202-	.0002	.0137-
.60	4.07	.1202-	.0305	.0477	.0205-	.0026	.0125-
.60	8.20	.1303-	.0200	.0495	.0221-	.0050	.0127-
.60	12.32	.1241-	.0074	.0417	.0210-	.0056	.0086-
.60	16.44	.0968-	.0044	.0616	.0202-	.0086	.0075-
.60	20.56	.0826-	.0035-	.0638	.0183-	.0126	.0093-
.60	23.60	.0634-	.0101-	.0517	.0179-	.0147	.0101-
.80	2.06-	.1134-	.0472	.0471	.0186-	.0007-	.0133-
.80	.01-	.1101-	.0430	.0494	.0189-	.0001	.0122-
.80	4.12	.1281-	.0294	.0535	.0199-	.0027	.0120-
.80	8.26	.1280-	.0202	.0516	.0205-	.0050	.0118-
.80	12.43	.0790-	.0159	.0305	.0196-	.0051	.0092-
.80	16.57	.0903-	.0051	.0317	.0179-	.0082	.0067-
.80	20.65	.0505-	.0500	.0153	.0099-	.0129	.0082-
.80	23.66	.0158	.0176	.0107	.0106-	.0103	.0000-
.85	2.06-	.1097-	.0470	.0499	.0184-	.0006-	.0133-
.85	.00-	.1117-	.0429	.0509	.0190-	.0005	.0118-
.85	4.13	.1316-	.0303	.0540	.0192-	.0026	.0122-
.85	8.29	.1303-	.0194	.0488	.0187-	.0047	.0114-
.85	12.43	.0714-	.0161	.0202	.0206-	.0054	.0092-
.85	16.59	.0659-	.0111	.0304	.0166-	.0078	.0068-
.85	20.65	.0028	.0159	.0075	.0102-	.0107	.0084-
.90	2.06-	.1085-	.0480	.0516	.0181-	.0003-	.0126-
.90	.00-	.1118-	.0433	.0519	.0178-	.0007	.0107-
.90	4.15	.1262-	.0318	.0553	.0184-	.0023	.0107-
.90	8.32	.1290-	.0220	.0685	.0184-	.0046	.0111-
.90	12.45	.1108-	.0112	.0534	.0199-	.0060	.0091-
.90	16.59	.0534-	.0170	.0231	.0165-	.0064	.0071-
.94	2.05-	.1113-	.0505	.0544	.0176-	.0005-	.0123-
.94	.09	.0468-	.0474	.0575	.0167-	.0001-	.0089-
.94	4.14	.1368-	.0358	.0565	.0176-	.0013	.0096-
.94	8.29	.1364-	.0231	.0651	.0171-	.0040	.0097-

TABLE V.- INCREMENTAL AERODYNAMIC CHARACTERISTICS OF 60° DELTA WING EQUIPPED WITH SPOILER 4

[Note that the minus signs are given after the values.

$c_s = 1.00c_r$; $y_i = 0.16b_l/2$; $y_o = 0.67b_l/2$]

(a) $\delta_s = -0.010\bar{c}$

M	α, deg	ΔC_L	ΔC_D	ΔC_m	ΔC_l	ΔC_n	ΔC_Y
.60	2.02-	.0247-	.0038	.0252	.0063-	.0004-	.0029-
.60	.01	.0295-	.0035	.0247	.0062-	.0002-	.0022-
.60	4.11	.0178-	.0021	.0227	.0063-	.0005	.0013-
.60	8.24	.0181-	.0013	.0227	.0063-	.0011	.0024-
.60	12.36	.0274-	.0019-	.0200	.0047-	.0009	.0024-
.60	16.49	.0201	.0079	.0376	.0039-	.0017	.0017-
.60	20.58	.0205	.0093	.0393	.0038-	.0019	.0024-
.60	23.55	.0936-	.0412-	.0308	.0022-	.0014	.0026-
.80	2.04-	.0319-	.0043	.0255	.0059-	.0006-	.0023-
.80	.02	.0288-	.0035	.0247	.0057-	.0003-	.0013-
.80	4.15	.0276-	.0016	.0232	.0055-	.0003	.0024-
.80	8.31	.0273-	.0004	.0258	.0057-	.0008	.0028-
.80	12.45	.0164-	.0001	.0167	.0036-	.0006	.0030-
.80	16.59	.0151-	.0011-	.0143	.0032-	.0012	.0019-
.80	20.66	.0016-	.0030	.0116	.0019-	.0015	.0024-
.80	23.65	.0076	.0069	.0114	.0013-	.0011	.0011-
.85	2.03-	.0250-	.0039	.0254	.0058-	.0007-	.0026-
.85	.02	.0281-	.0035	.0258	.0057-	.0004-	.0017-
.85	4.16	.0225-	.0021	.0231	.0053-	.0002	.0023-
.85	8.24	.1039-	.0110-	.0225	.0055-	.0006	.0031-
.85	12.47	.0079-	.0022	.0148	.0025-	.0002	.0031-
.85	16.61	.0034	.0044	.0108	.0020-	.0007	.0025-
.85	20.65	.0148	.0096	.0042	.0013-	.0011	.0022-
.90	2.03-	.0248-	.0044	.0252	.0052-	.0007-	.0037-
.90	.03	.0207-	.0035-	.0238	.0051-	.0003-	.0020-
.90	4.18	.0193-	.0024	.0235	.0046-	.0001	.0018-
.90	8.33	.0314-	.0001	.0301	.0053-	.0006	.0041-
.90	12.48	.0592-	.0073-	.0417	.0087-	.0025	.0036-
.90	16.59	.0006	.0036	.0059	.0011-	.0001	.0028-
.94	2.03-	.0196-	.0042	.0241	.0050-	.0008-	.0036-
.94	.04	.0210-	.0039	.0232	.0046-	.0005-	.0019-
.94	4.17	.0122-	.0034	.0163	.0039-	.0001-	.0020-
.94	8.30	.0044-	.0040	.0126	.0034-	.0002	.0026-

[redacted]

TABLE V.- Continued

INCREMENTAL AERODYNAMIC CHARACTERISTICS OF 60° DELTA WING EQUIPPED WITH SPOILER 4

$\left[c_s = 1.00c_r;\ y_i = 0.16b_l/2;\ y_o = 0.67b_l/2\right]$

(b) $\delta_s = -0.025\bar{c}$.

M	α, deg	ΔC_L	ΔC_D	ΔC_m	ΔC_l	ΔC_n	ΔC_Y
.60	2.03-	.0639-	.0143	.0436	.0119-	.0013-	.0053-
.60	.01	.0667-	.0129	.0431	.0120-	.0009-	.0046-
.60	4.10	.0633-	.0074	.0405	.0120-	.0009	.0034-
.60	8.22	.0659-	.0037	.0401	.0118-	.0014	.0053-
.60	12.35	.0497-	.0014	.0327	.0098-	.0017	.0042-
.60	16.46	.0487-	.0049-	.0519	.0081-	.0031	.0042-
.60	20.57	.0242-	.0016-	.0508	.0071-	.0036	.0047-
.60	23.63	.0103-	.0010	.0467	.0053-	.0034	.0032-
.80	2.02-	.0642-	.0143	.0435	.0112-	.0015-	.0051-
.80	.02	.0663-	.0123	.0433	.0111-	.0009-	.0032-
.80	4.16	.0627-	.0068	.0411	.0107-	.0006	.0026-
.80	8.31	.0645-	.0042	.0424	.0108-	.0012	.0048-
.80	12.45	.0486-	.0004-	.0302	.0069-	.0011	.0047-
.80	16.60	.0401-	.0015-	.0264	.0069-	.0027	.0032-
.80	20.67	.0184-	.0013	.0201	.0041-	.0031	.0044-
.80	23.63	.0159-	.0011	.0116	.0031-	.0027	.0018-
.85	2.02-	.0567-	.0128	.0428	.0109-	.0013-	.0052-
.85	.04	.0602-	.0102	.0439	.0110-	.0006-	.0033-
.85	4.17	.0598-	.0063	.0412	.0102-	.0006	.0033-
.85	8.32	.0615-	.0034	.0421	.0101-	.0012	.0044-
.85	12.47	.0313-	.0034	.0230	.0054-	.0008	.0042-
.85	16.61	.0260-	.0021	.0221	.0054-	.0021	.0034-
.85	20.64	.0065-	.0064	.0096	.0034-	.0035	.0029-
.90	2.01-	.0547-	.0121	.0424	.0103-	.0012-	.0061-
.90	.05	.0537-	.0109	.0419	.0103-	.0006-	.0028-
.90	4.18	.0543-	.0073	.0403	.0095-	.0003	.0024-
.90	8.34	.0596-	.0041	.0454	.0098-	.0010	.0054-
.90	12.49	.0605-	.0003-	.0457	.0123-	.0030	.0053-
.90	16.59	.0129-	.0051	.0106	.0034-	.0007	.0041-
.94	2.01-	.0509-	.0125	.0408	.0098-	.0014-	.0052-
.94	.05	.0538-	.0120	.0411	.0098-	.0010-	.0028-
.94	4.18	.0534-	.0084	.0383	.0091-	.0000-	.0027-
.94	8.43	.0420-	.0068	.0779	.0090-	.0007	.0045-

[redacted]

TABLE V.- Concluded

INCREMENTAL AERODYNAMIC CHARACTERISTICS OF 60° DELTA WING EQUIPPED WITH SPOILER 4

$\left[c_s = 1.00c_r;\ y_i = 0.16b_l/2;\ y_o = 0.67b_l/2\right]$

(c) $\delta_s = -0.050\bar{c}$

M	α, deg	ΔC_L	ΔC_D	ΔC_m	ΔC_l	ΔC_n	ΔC_Y
.60	2.04-	.1179-	.0294	.0616	.0188-	.0019-	.0131-
.60	.01-	.1213-	.0257	.0605	.0187-	.0013-	.0143-
.60	4.11	.0995-	.0174	.0578	.0182-	.0009	.0128-
.60	8.22	.1203-	.0096	.0573	.0181-	.0024	.0152-
.60	12.33	.1111-	.0000-	.0454	.0145-	.0023	.0143-
.60	16.46	.0900-	.0055-	.0634	.0126-	.0053	.0122-
.60	20.56	.0745-	.0096-	.0626	.0114-	.0064	.0165-
.60	23.60	.0553-	.0105-	.0562	.0099-	.0068	.0136-
.80	2.03-	.1066-	.0286	.0591	.0167-	.0021-	.0123-
.80	.03	.0996-	.0233	.0586	.0167-	.0013-	.0107-
.80	4.15	.1083-	.0154	.0567	.0161-	.0008	.0105-
.80	8.30	.1109-	.0117	.0583	.0161-	.0014	.0131-
.80	12.45	.0674-	.0071	.0361	.0103-	.0015	.0121-
.80	16.58	.0678-	.0008	.0324	.0098-	.0044	.0107-
.80	20.65	.0456-	.0006-	.0267	.0058-	.0051	.0120-
.80	23.57	.0873-	.0254-	.0081	.0032-	.0017	.0093-
.85	2.03-	.1007-	.0266	.0576	.0161-	.0019-	.0128-
.85	.04	.1016-	.0222	.0600	.0162-	.0009-	.0104-
.85	4.17	.1023-	.0155	.0567	.0155-	.0008	.0115-
.85	8.32	.1124-	.0105	.0580	.0153-	.0015	.0126-
.85	12.46	.0703-	.0051	.0342	.0086-	.0012	.0121-
.85	16.60	.0931-	.0089-	.0486	.0088-	.0041	.0114-
.85	20.64	.0335-	.0039	.0183	.0044-	.0041	.0113-
.90	2.01-	.0931-	.0249	.0587	.0154-	.0014-	.0127-
.90	.04	.0859-	.0226	.0559	.0155-	.0006-	.0093-
.90	4.18	.0931-	.0156	.0566	.0146-	.0009	.0103-
.90	8.34	.1034-	.0104	.0641	.0149-	.0018	.0132-
.90	12.48	.0913-	.0048	.0539	.0148-	.0031	.0120-
.90	16.61	.0578-	.0000-	.0399	.0085-	.0039	.0100-
.94	2.01-	.0834-	.0272	.0564	.0151-	.0019-	.0121-
.94	.05	.0736-	.0247	.0550	.0147-	.0010-	.0090-
.94	4.19	.0860-	.0189	.0567	.0139-	.0003	.0097-
.94	8.35	.0778-	.0174	.0599	.0147-	.0010	.0117-

TABLE VI.- INCREMENTAL AERODYNAMIC CHARACTERISTICS OF 60° DELTA WING EQUIPPED WITH SPOILER 5

[Note that the minus signs are given after the values.

$c_s = 0.85c_r;\ y_i = 0.20b_l/2;\ y_o = 0.33b_l/2;\ \delta_s = -0.050\bar{c}$]

M	α, deg	ΔC_L	ΔC_D	ΔC_m	ΔC_l	ΔC_n	ΔC_Y
.60	2.05-	.0061-	.0066	.0023	.0024-	.0014	.0082-
.60	.01-	.0135-	.0070	.0022	.0027-	.0014	.0109-
.60	4.09	.0115-	.0060	.0038	.0036-	.0020	.0095-
.60	8.21	.0168-	.0050	.0038	.0041-	.0026	.0101-
.60	12.34	.0158-	.0035	.0011	.0020-	.0012	.0091-
.60	16.46	.0025-	.0069	.0217	.0063-	.0030	.0082-
.60	20.56	.0061	.0120	.0295	.0076-	.0054	.0084-
.60	23.59	.0311-	.0051-	.0343	.0103-	.0090	.0093-
.80	2.07-	.0220-	.0086	.0066	.0033-	.0014	.0083-
.80	.02-	.0239-	.0078	.0061	.0034-	.0015	.0082-
.80	4.12	.0326-	.0056	.0093	.0043-	.0024	.0081-
.80	8.26	.0356-	.0029	.0110	.0043-	.0026	.0086-
.80	12.41	.0079-	.0056	.0007-	.0004-	.0007	.0065-
.80	16.56	.0362-	.0005	.0069	.0101-	.0049	.0049-
.80	20.65	.0211-	.0005	.0108	.0085-	.0083	.0074-
.80	23.64	.0167	.0146	.0011	.0100-	.0100	.0021-
.85	2.07-	.0264-	.0090	.0083	.0035-	.0013	.0095-
.85	.02-	.0269-	.0079	.0080	.0038-	.0017	.0085-
.85	4.12	.0379-	.0054	.0120	.0046-	.0025	.0084-
.85	8.28	.0398-	.0028	.0111	.0046-	.0030	.0058-
.85	12.76	.3224	.0803	.0046	.0065-	.0026	.0044-
.85	16.57	.0231-	.0046	.0060	.0105-	.0053	.0059-
.85	20.65	.0155	.0143	.0017	.0083-	.0085	.0039-
.90	2.07-	.0277-	.0097	.0099	.0038-	.0015	.0089-
.90	.02-	.0412-	.0087	.0087	.0040-	.0019	.0069-
.90	4.13	.0382-	.0058	.0139	.0032-	.0027	.0069-
.90	8.29	.0589-	.0007	.0232	.0051-	.0032	.0094-
.90	12.44	.0282-	.0022	.0149	.0061-	.0029	.0064-
.90	16.58	.0114-	.0076	.0028	.0091-	.0039	.0042-
.94	2.07-	.0373-	.0105	.0134	.0043-	.0016	.0082-
.94	.01-	.0309-	.0091	.0110	.0041-	.0018	.0077-
.94	4.13	.0412-	.0065	.0136	.0051-	.0026	.0075-
.94	8.29	.0551-	.0009	.0259	.0053-	.0034	.0086-

TABLE VII.- INCREMENTAL AERODYNAMIC CHARACTERISTICS OF 60° DELTA WING EQUIPPED WITH SPOILER 6

[Note that the minus signs are given after the values.

$c_s = 0.85c_r$; $y_i = 0.33b_l/2$; $y_o = 0.67b_l/2$; $\delta_s = -0.050\bar{c}$]

M	α, deg	ΔC_L	ΔC_D	ΔC_m	ΔC_l	ΔC_n	ΔC_Y
.60	2.06-	.0189-	.0082	.0000-	.0026-	.0016-	.0042-
.60	.02-	.0295-	.0076	.0013	.0034	.0018-	.0019-
.60	4.07	.0338-	.0055	.0038	.0050-	.0009-	.0017-
.60	8.19	.0463-	.0014	.0085	.0097-	.0001	.0020-
.60	12.31	.0722-	.0085-	.0047	.0075-	.0007	.0004-
.60	16.46	.0214-	.0011-	.0319	.0093-	.0030	.0016-
.60	20.54	.0250-	.0052-	.0333	.0082-	.0044	.0012-
.60	23.59	.0250-	.0076-	.0344	.0080-	.0058	.0035-
.80	2.08-	.0317-	.0096	.0060	.0041-	.0016-	.0020-
.80	.02-	.0352-	.0090	.0073	.0048-	.0012-	.0011-
.80	4.11	.0467-	.0057	.0105	.0064-	.0007-	.0016-
.80	8.27	.0613-	.0008	.0186	.0110-	.0008	.0022-
.80	12.41	.0371-	.0023-	.0049	.0063-	.0010	.0019-
.80	16.54	.0848-	.0203-	.0200	.0090-	.0042	.0010-
.80	20.64	.0175-	.0052-	.0082	.0070-	.0049	.0029-
.80	23.63	.0035	.0018	.0017	.0035-	.0028	.0017-
.85	2.08-	.0369-	.0102	.0082	.0047-	.0015-	.0025-
.85	.02-	.0371-	.0094	.0100	.0056-	.0012-	.0016-
.85	4.12	.0453-	.0064	.0124	.0070-	.0005-	.0024-
.85	8.27	.0637-	.0013	.0181	.0109-	.0007	.0026-
.85	12.43	.0188	.0076	.0142-	.0131-	.0033	.0028-
.85	16.57	.0328-	.0052-	.0105	.0088-	.0044	.0029-
.85	20.64	.0033	.0025	.0008	.0046-	.0047	.0030-
.90	2.07-	.0504-	.0126	.0173	.0042-	.0017-	.0045-
.90	.02-	.0461-	.0114	.0138	.0064-	.0011-	.0025-
.90	4.12	.0319-	.0104	.0062	.0068-	.0008-	.0023-
.90	8.29	.0678-	.0010	.0230	.0107-	.0007	.0040-
.90	12.43	.0609-	.0059-	.0214	.0146-	.0044	.0023-
.90	16.58	.0042	.0060	.0003-	.0065-	.0031	.0022-
.94	2.07-	.0448-	.0120	.0155	.0060-	.0016-	.0041-
.94	.02-	.0468-	.0107	.0133	.0061-	.0011-	.0024-
.94	4.12	.0484-	.0079	.0131	.0066-	.0012-	.0025-
.94	8.28	.0833-	.0028-	.0361	.0101-	.0005	.0030-

TABLE VIII.- INCREMENTAL AERODYNAMIC CHARACTERISTICS OF 60° DELTA WING EQUIPPED WITH SPOILER 7

[Note that the minus signs are given after the values.

$c_s = 0.85c_r$; $y_i = 0.67b_l/2$; $y_o = 1.00b_l/2$; $\delta_s = -0.050\bar{c}$]

M	α, deg	ΔC_L	ΔC_D	ΔC_m	ΔC_l	ΔC_n	ΔC_Y
.60	2.05-	.0179-	.0084	.0012	.0031-	.0030-	.0015-
.60	.03-	.0325-	.0083	.0039	.0047-	.0028-	.0011-
.60	4.09	.0280-	.0047	.0054	.0064-	.0022-	.0010-
.60	8.20	.0234-	.0013	.0045	.0056-	.0011-	.0002
.60	12.33	.0259-	.0012-	.0035	.0054-	.0002-	.0011
.60	16.45	.0157-	.0025-	.0236	.0057-	.0012	.0003
.60	20.54	.0121-	.0034-	.0274	.0044-	.0024	.0001
.60	23.60	.0046-	.0026-	.0285	.0035-	.0026	.0005-
.80	2.08-	.0306-	.0108	.0065	.0051-	.0032-	.0010-
.80	.02-	.0373-	.0097	.0087	.0061-	.0030-	.0015-
.80	4.11	.0363-	.0054	.0076	.0065-	.0022-	.0008-
.80	8.26	.0413-	.0000-	.0122	.0074-	.0005-	.0005
.80	12.41	.0336-	.0029-	.0035	.0046-	.0000-	.0003-
.80	16.56	.0353-	.0073-	.0059	.0058-	.0022	.0003
.80	20.63	.0090-	.0037-	.0019	.0015-	.0017	.0009-
.80	23.62	.0021	.0009-	.0033-	.0011	.0014-	.0001
.85	2.07-	.0311-	.0109	.0095	.0056-	.0033-	.0012-
.85	.02-	.0406-	.0092	.0115	.0071-	.0030-	.0012-
.85	4.11	.0427-	.0052	.0091	.0065-	.0023-	.0014-
.85	8.28	.0448-	.0006-	.0093	.0071-	.0005-	.0004
.85	12.43	.0025	.0031	.0113-	.0112-	.0021	.0003-
.85	16.55	.0287-	.0057-	.0025	.0050-	.0020	.0004-
.85	20.63	.0149	.0059	.0045-	.0013-	.0018	.0002
.90	2.07-	.0347-	.0122	.0115	.0065-	.0035-	.0022-
.90	.05	.0376-	.0109	.0398	.0078-	.0029-	.0010-
.90	4.12	.0458-	.0059	.0095	.0067-	.0023-	.0007-
.90	8.27	.0476-	.0003	.0111	.0078-	.0006-	.0010-
.90	12.46	.0340-	.0018-	.0226	.0130-	.0032	.0012-
.90	16.57	.0082-	.0017	.0027-	.0049-	.0015	.0012-
.94	2.07-	.0384-	.0126	.0145	.0071-	.0035-	.0031-
.94	.01-	.0443-	.0117	.0154	.0082-	.0030-	.0011-
.94	4.12	.0463-	.0063	.0108	.0066-	.0025-	.0007-
.94	8.26	.0510-	.0000-	.0143	.0081-	.0004-	.0001

TABLE IX.- INCREMENTAL AERODYNAMIC CHARACTERISTICS OF 60° DELTA WING EQUIPPED WITH SPOILER 8

[Note that the minus signs are given after the values.

$c_s = 0.85c_r$; $y_i = 0.20b_l/2$; $y_o = 1.00b_l/2$; $\delta_s = -0.050\bar{c}$]

M	α, deg	ΔC_L	ΔC_D	ΔC_m	ΔC_l	ΔC_n	ΔC_Y
.60	2.06-	.0671-	.0296	.0196	.0118-	.0013-	.0125-
.60	.03-	.0824-	.0276	.0223	.0137-	.0006-	.0113-
.60	4.06	.0909-	.0203	.0267	.0165-	.0012	.0105-
.60	8.18	.0917-	.0113	.0231	.0163-	.0031	.0099-
.60	12.32	.0765-	.0040	.0118	.0125-	.0031	.0062-
.60	16.41	.0883-	.0090-	.0360	.0126-	.0050	.0044-
.60	20.55	.0303-	.0152	.0357	.0119-	.0069	.0048-
.60	23.60	.0313-	.0008-	.0375	.0149-	.0100	.0097-
.80	2.08-	.0834-	.0337	.0253	.0127-	.0013-	.0097-
.80	.02-	.0844-	.0315	.0289	.0147-	.0005-	.0101-
.80	4.10	.1035-	.0230	.0328	.0163-	.0012	.0103-
.80	8.26	.0926-	.0125	.0286	.0155-	.0031	.0100-
.80	12.41	.0147-	.0157	.0017-	.0159-	.0044	.0054-
.80	16.55	.0579-	.0004	.0138	.0130-	.0054	.0043-
.80	20.65	.0193-	.0034	.0103	.0098-	.0075	.0066-
.80	23.66	.0282	.0184	.0058	.0099-	.0088	.0006-
.85	2.07-	.0712-	.0347	.0292	.0129-	.0013-	.0109-
.85	.01-	.0814-	.0323	.0313	.0148-	.0005-	.0100-
.85	4.12	.0935-	.0248	.0328	.0160-	.0012	.0105-
.85	8.28	.0853-	.0148	.0275	.0151-	.0033	.0092-
.85	12.42	.0000-	.0181	.0093-	.0155-	.0044	.0065-
.85	16.58	.0353-	.0073	.0121	.0129-	.0053	.0051-
.85	20.65	.0194	.0179	.0041	.0103-	.0080	.0056-
.90	2.13-	.0712-	.0363	.0059	.0128-	.0013-	.0115-
.90	.05-	.0831-	.0331	.0140	.0150-	.0003-	.0095-
.90	4.13	.0929-	.0272	.0372	.0149-	.0009	.0103-
.90	8.27	.1736-	.0025	.0641	.0146-	.0030	.0110-
.90	12.59	.0870-	.0047	.0971	.0179-	.0055	.0090-
.90	16.76	.0272-	.0077	.0909	.0124-	.0051	.0043-
.94	2.13-	.0693-	.0391	.0028	.0110-	.0015-	.0106-
.94	.05-	.0722-	.0383	.0124	.0127-	.0008-	.0091-
.94	4.13	.0952-	.0305	.0377	.0125-	.0002	.0089-
.94	8.37	.1015-	.0158	.0780	.0124-	.0021	.0084-

[redacted]

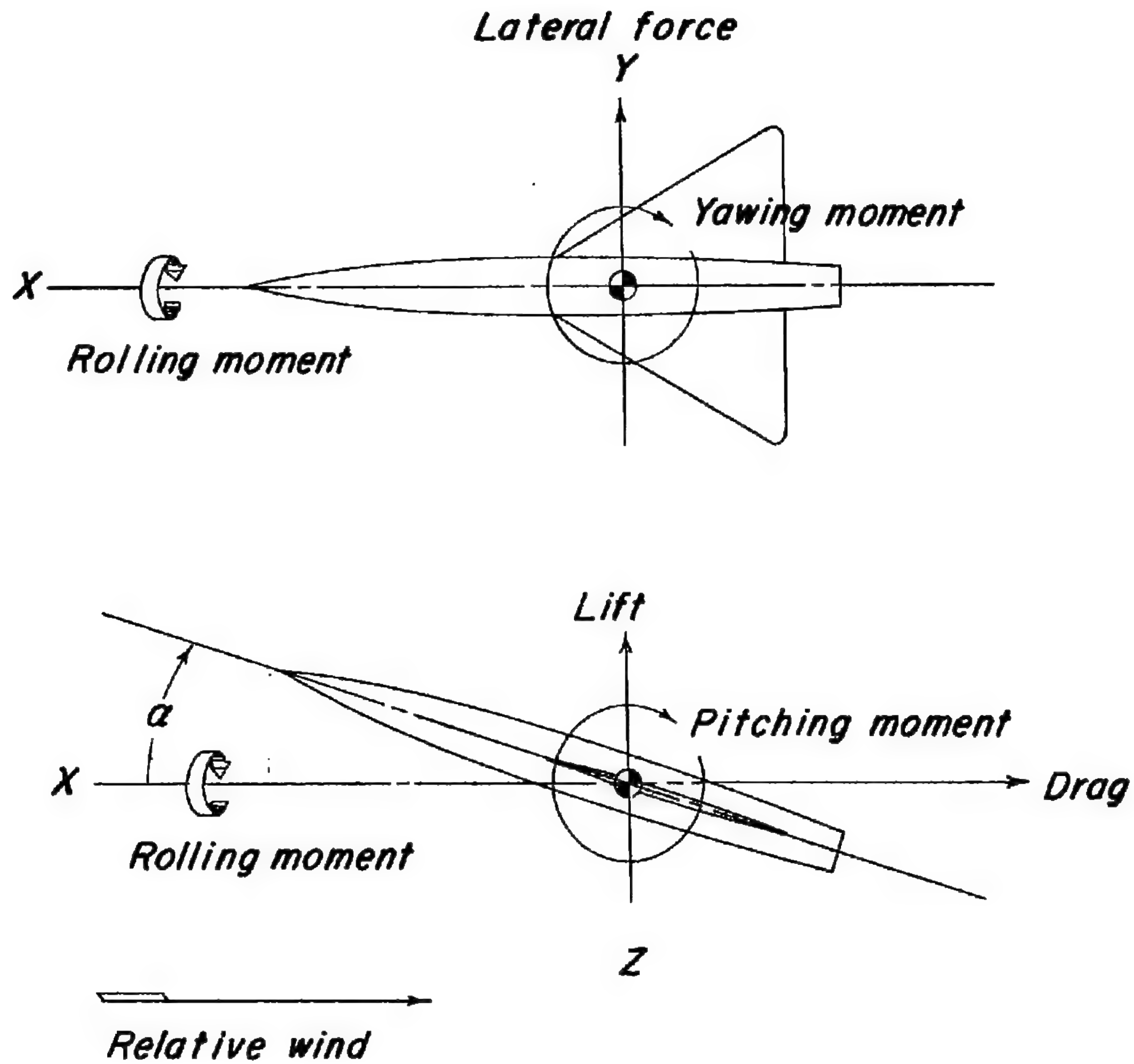
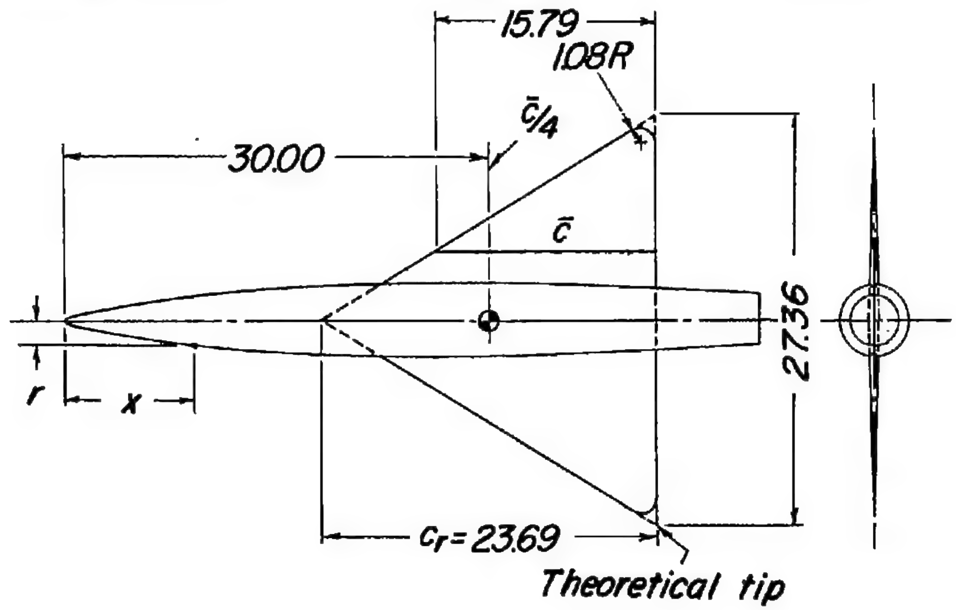


Figure 1.- System of stability axes used. (Positive values of forces, moments, and angles are indicated by arrows.)

[redacted]

Wing Geometry

	(To theoretical tip)	(To actual tip)
L.E. Sweep	60°	
Airfoil section parallel to plane of symmetry	NACA 65A003	
Area	2.25	2.24 sq ft
Span	2.28	2.15 ft
Mean aerodynamic chord	1.32	1.32 ft
Aspect ratio	2.31	2.06



Fuselage Ordinates (inches)	
x	r
0	0
.30	.139
.45	.179
.75	.257
1.50	.433
3.00	.723
4.50	.968
6.00	1.183
9.00	1.556
12.00	1.854
15.00	2.079
18.00	2.245
21.00	2.360
24.00	2.438
27.00	2.486
30.00	2.500
33.00	2.478
36.00	2.414
39.00	2.305
42.00	2.137
49.20	1.650
L.E. radius = 0.030	

Figure 2.- General arrangement of thin 60° delta wing-fuselage model. (All dimensions in inches unless otherwise noted.)

Spoiler Characteristics

Spoiler	c_s	c_s/c_r	y_i	$y_i/b_{l/2}$	y_o	$y_o/b_{l/2}$	b_s	$b_s/b_{l/2}$
	(ft)		(ft)		(ft)		(ft)	
1	1.184	0.60	0.207	0.30	0.456	0.67	0.249	0.36
2	1.678	.85	.194	.20	.646	.67	.452	.47
3	1.836	.93	.187	.18	.707	.67	.520	.49
4	1.974	1.00	.179	.16	.760	.67	.581	.51
5	1.678	.85	.194	.20	.323	.33	.129	.13
6	1.678	.85	.323	.33	.646	.67	.323	.33
7	1.678	.85	.646	.67	.969	1.00	.323	.33
8	1.678	.85	.194	.20	.969	1.00	.775	.80

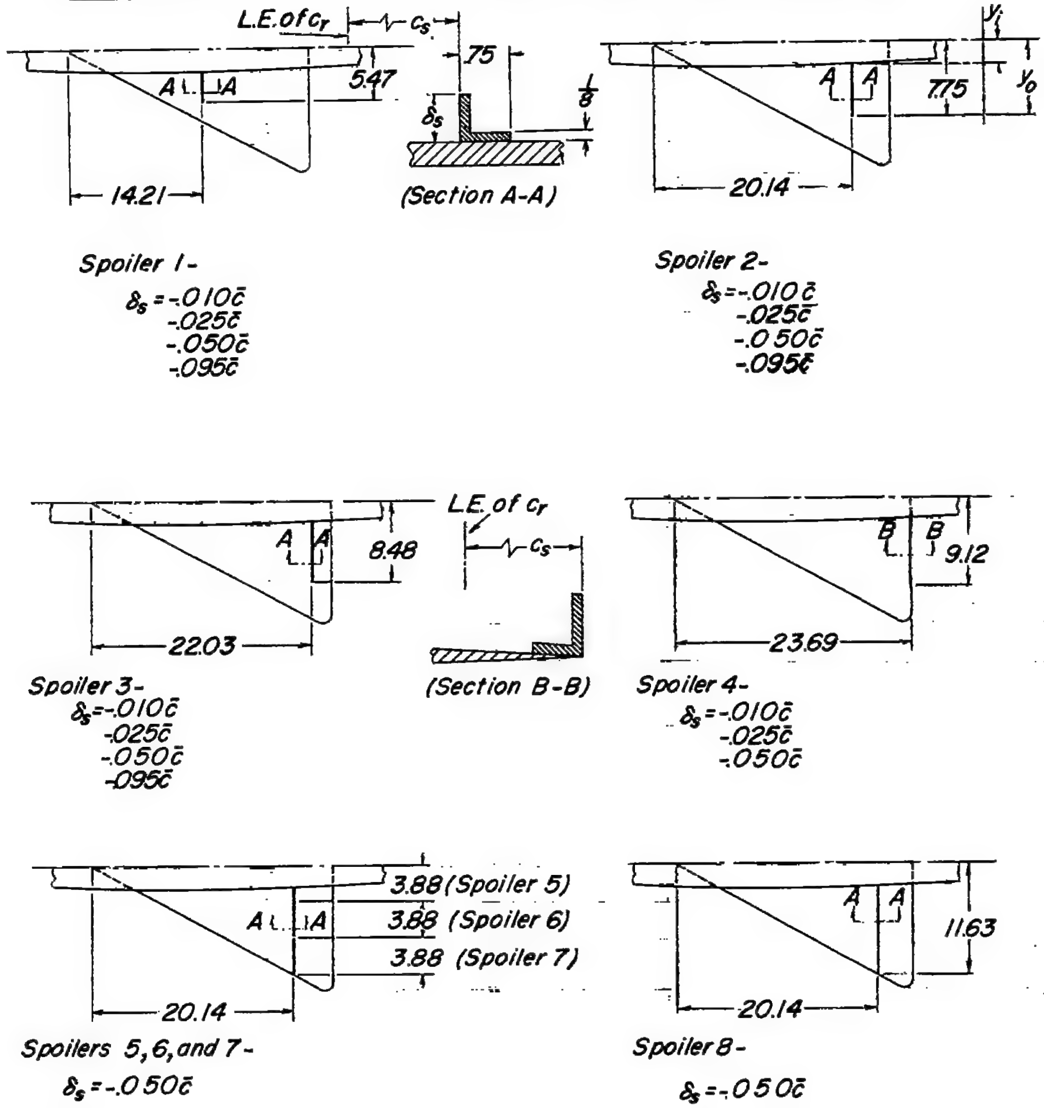


Figure 3.- Details of various spoiler configurations tested on thin 60° delta wing. (All dimensions in inches unless otherwise noted.)

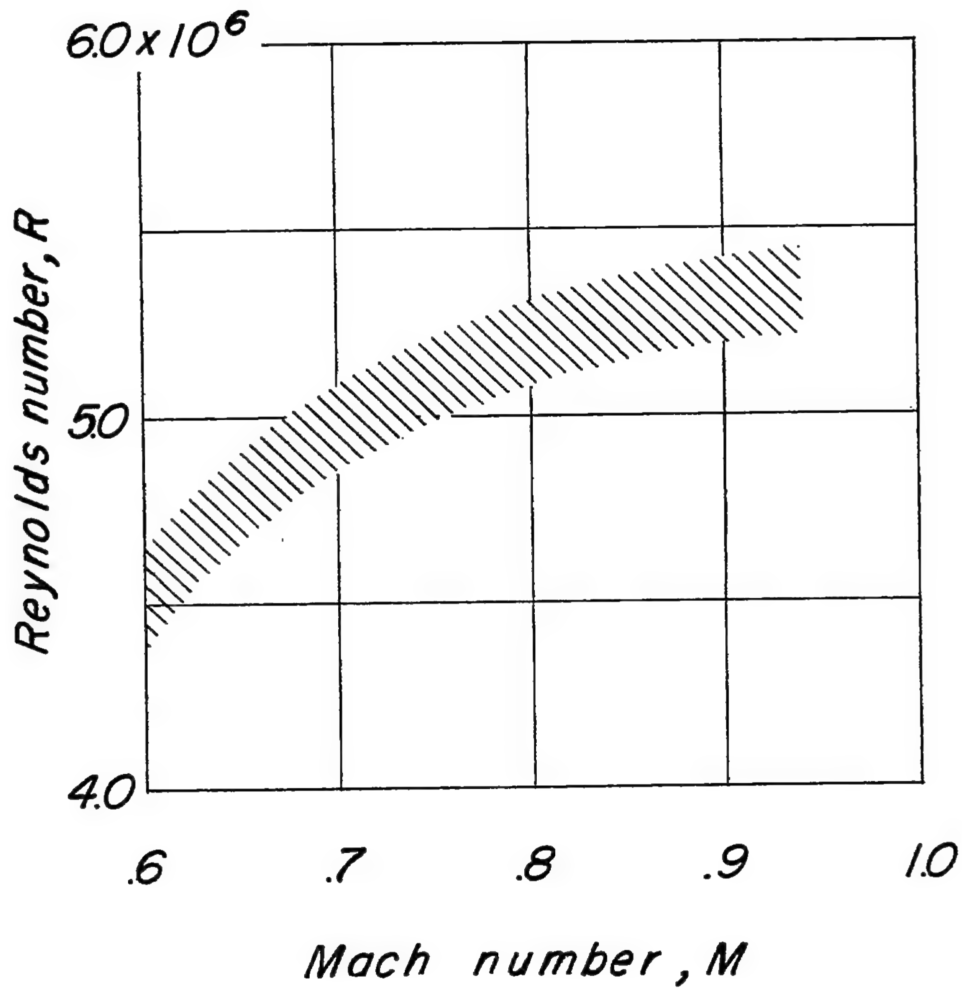


Figure 4.- The variation of test Reynolds number with Mach number. (Variations of tunnel temperature account for variation of R at constant M.)

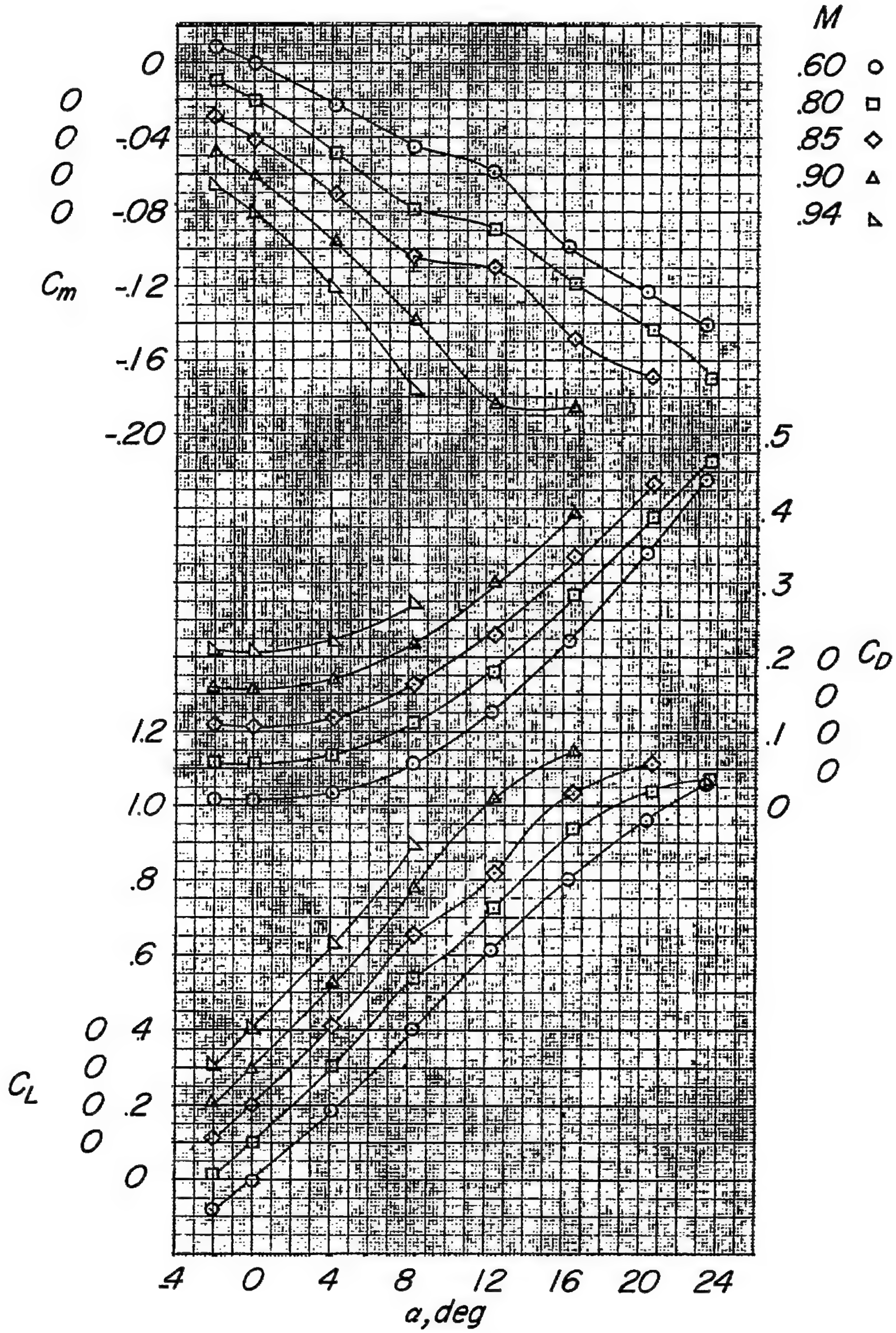


Figure 5.- The aerodynamic characteristics of the plain 60° delta wing.

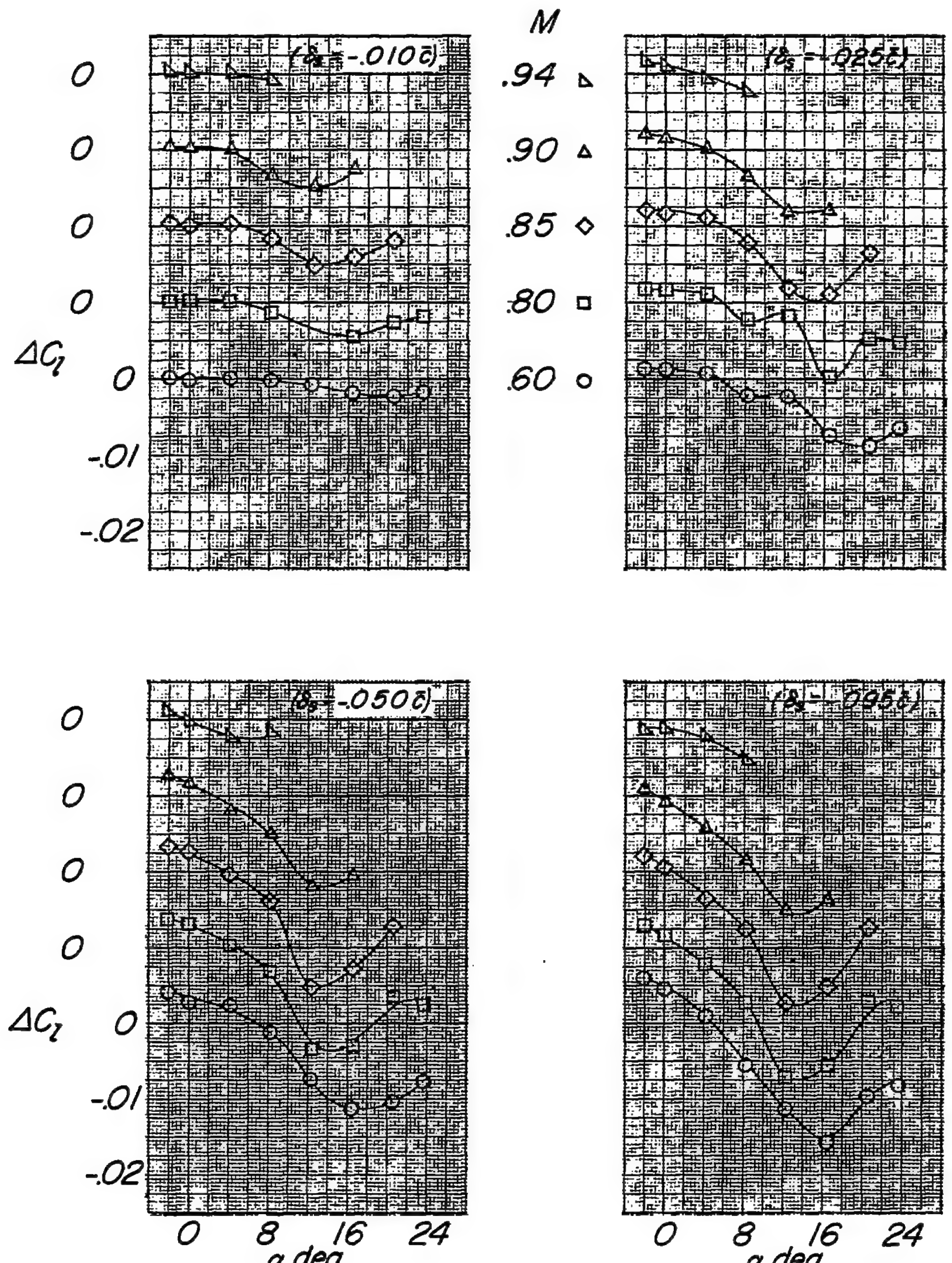


Figure 6.- Variation of incremental rolling-moment coefficient with angle of attack for spoiler 1 at various projections. $c_s = 0.60c_r$; $y_i = 0.30\frac{b_l}{2}$; $y_o = 0.67\frac{b_l}{2}$.

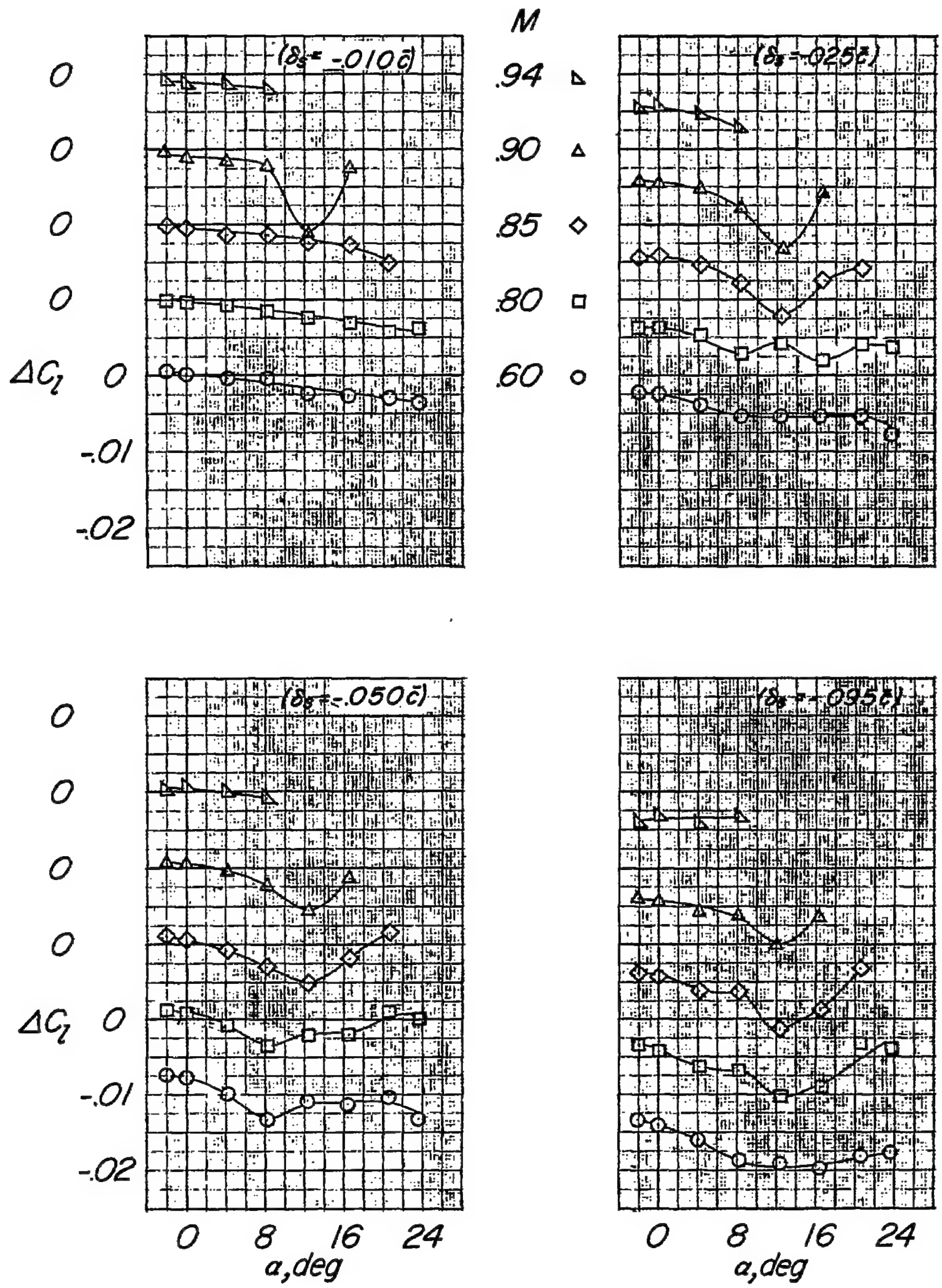


Figure 7.- Variation of incremental rolling-moment coefficient with angle of attack for spoiler 2 at various projections. $c_s = 0.85c_r$; $y_i = 0.20\frac{b_l}{2}$; $y_o = 0.67\frac{b_l}{2}$.

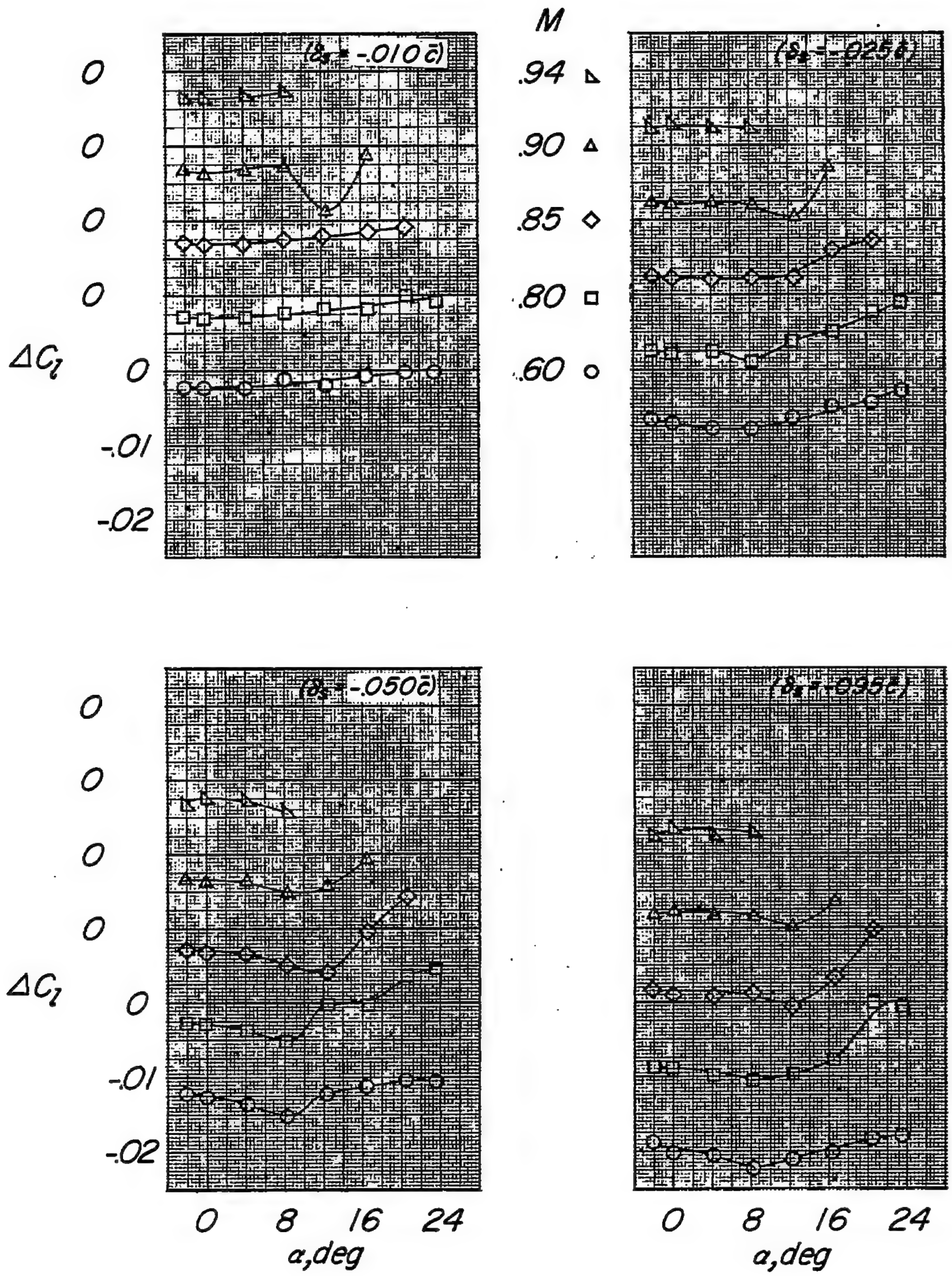


Figure 8.- Variation of incremental rolling-moment coefficient with angle of attack for spoiler 3 at various projections. $c_s = 0.93c_r$; $y_i = 0.18\frac{b_l}{2}$; $y_o = 0.67\frac{b_l}{2}$.

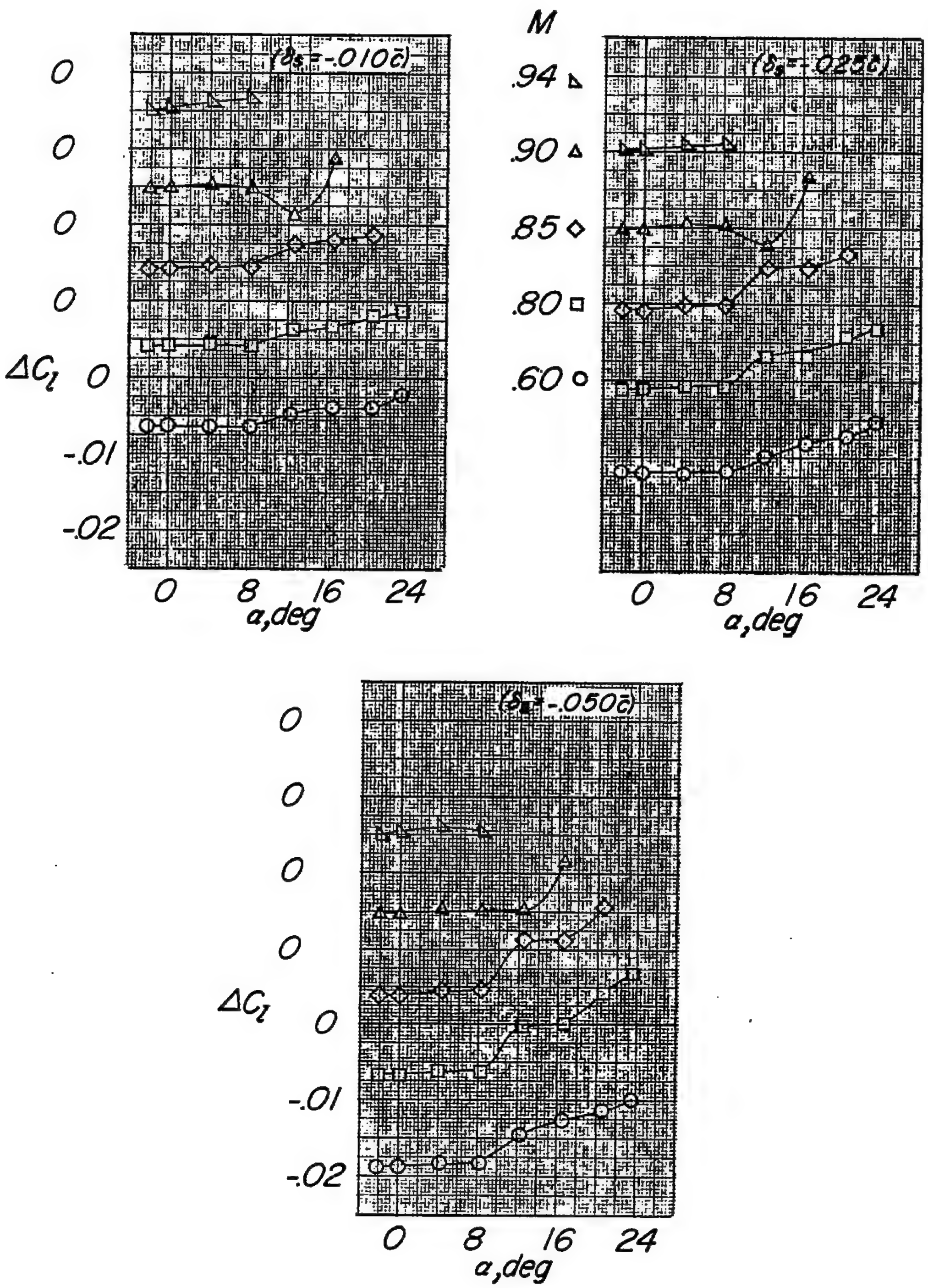


Figure 9.- Variation of incremental rolling-moment coefficient with angle of attack for spoiler 4 at various projections. $c_s = 1.00c_r$; $y_i = 0.16\frac{b_l}{2}$; $y_o = 0.67\frac{b_l}{2}$.

A

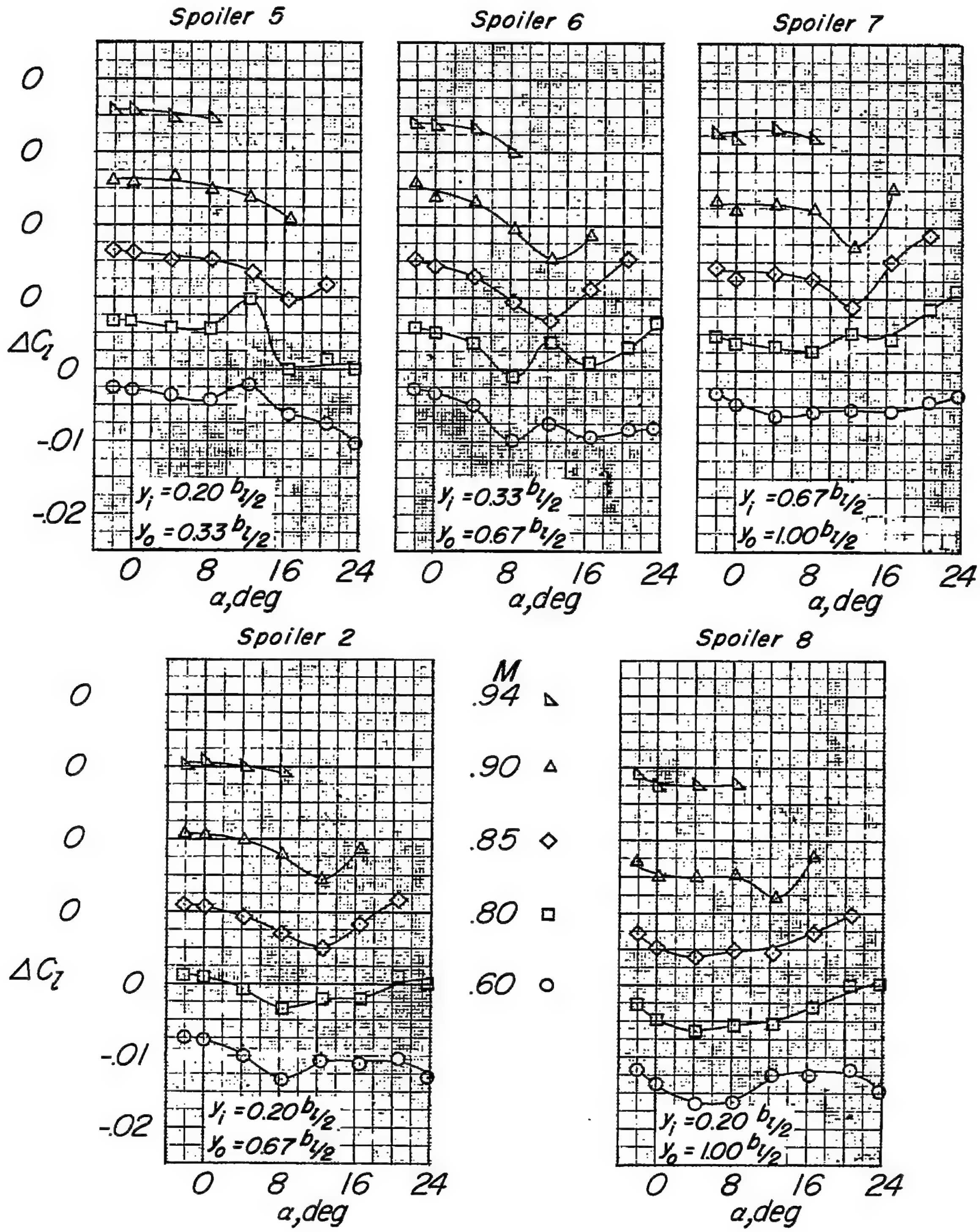


Figure 10.- Variation of incremental rolling-moment coefficient with angle of attack for spoilers 5, 6, 7, 2, and 8 with various spoiler spans and spanwise locations. $c_s = 0.85c_r$; $\delta_s = -0.050\bar{c}$.

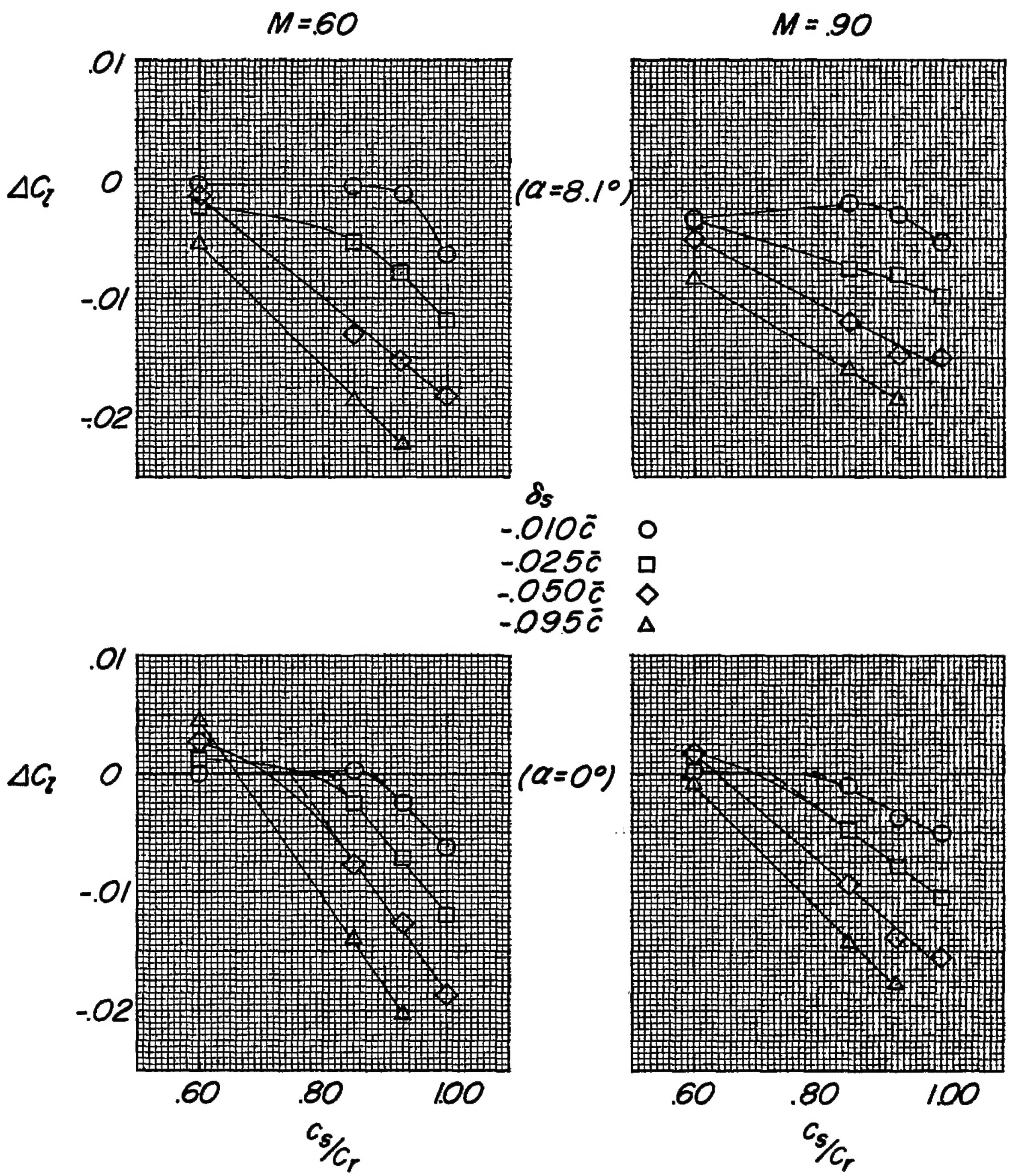


Figure 11.- Variation of incremental rolling-moment coefficient with chordwise location of spoiler at various spoiler deflections. (All spoilers extend from fuselage to $0.67\frac{b_l}{2}$.)

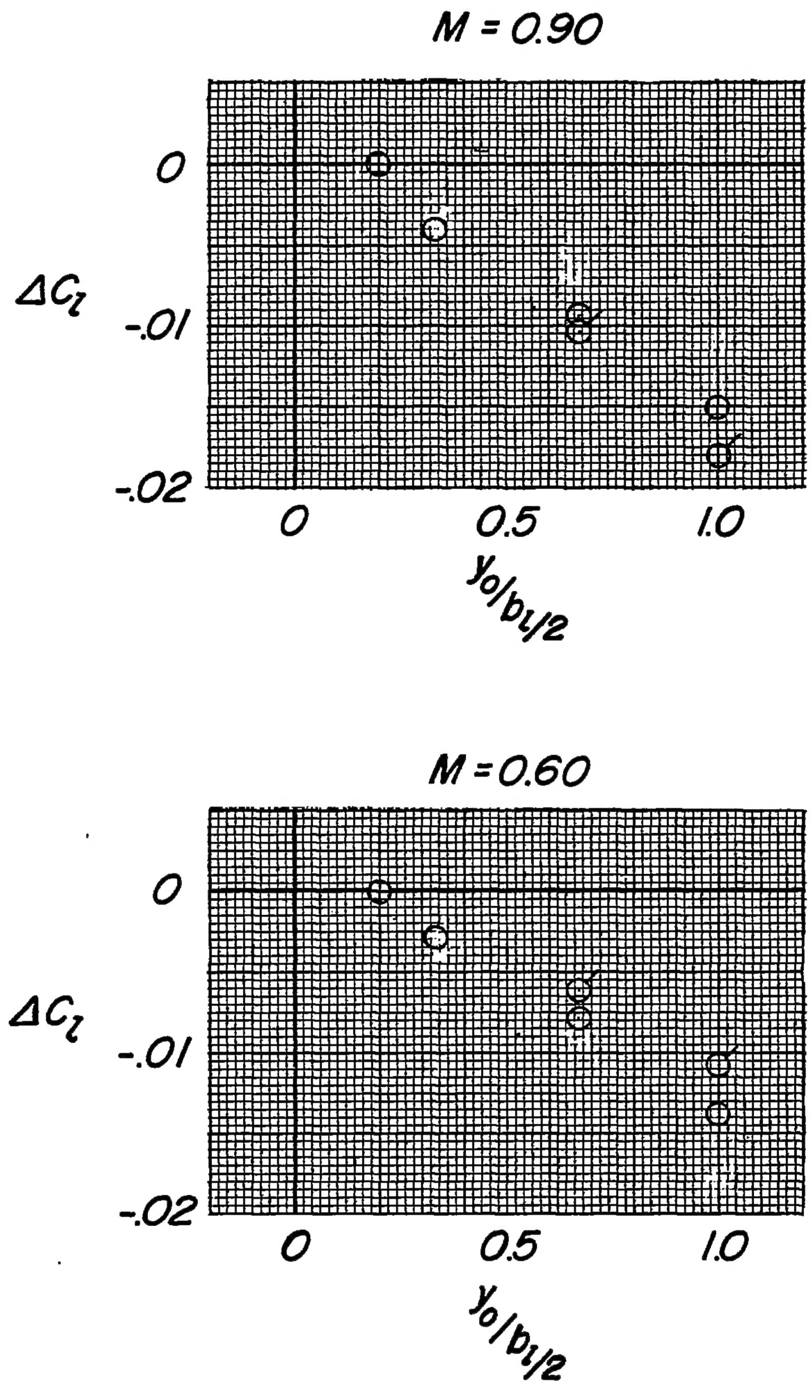


Figure 12.- Variation of incremental rolling-moment coefficient with spoiler span. Flagged symbols indicate values obtained by adding incremental contributions of spoilers 5, 2, and 8. $c_s = 0.8sc_r$; $\delta_s = -0.050\bar{c}$; $\alpha = 0^{\circ}$.

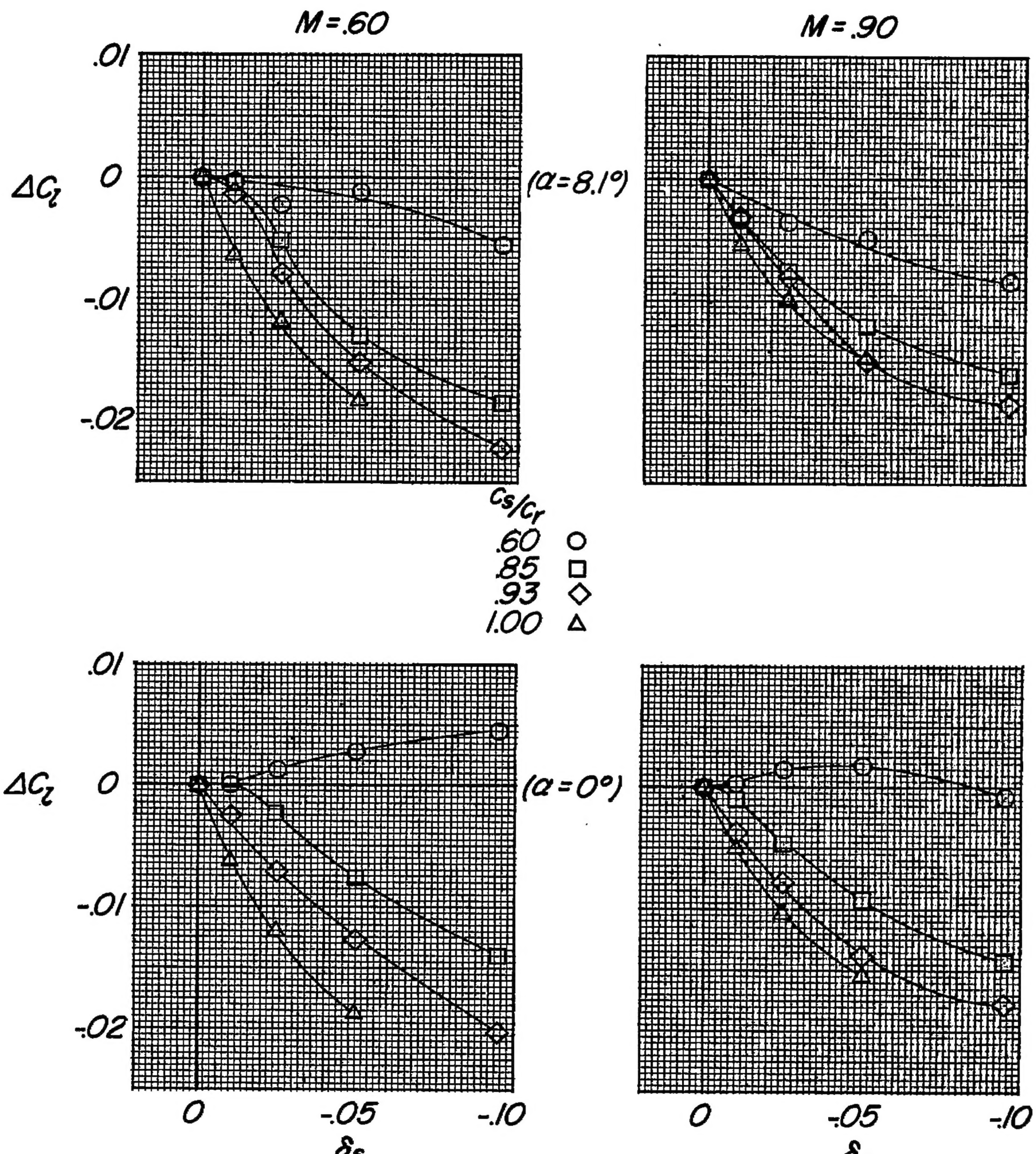


Figure 13.- Variation of incremental rolling-moment coefficient with spoiler projection at various chordwise locations of spoiler. (All spoilers extend from fuselage to $0.67\frac{b_l}{2}$.)

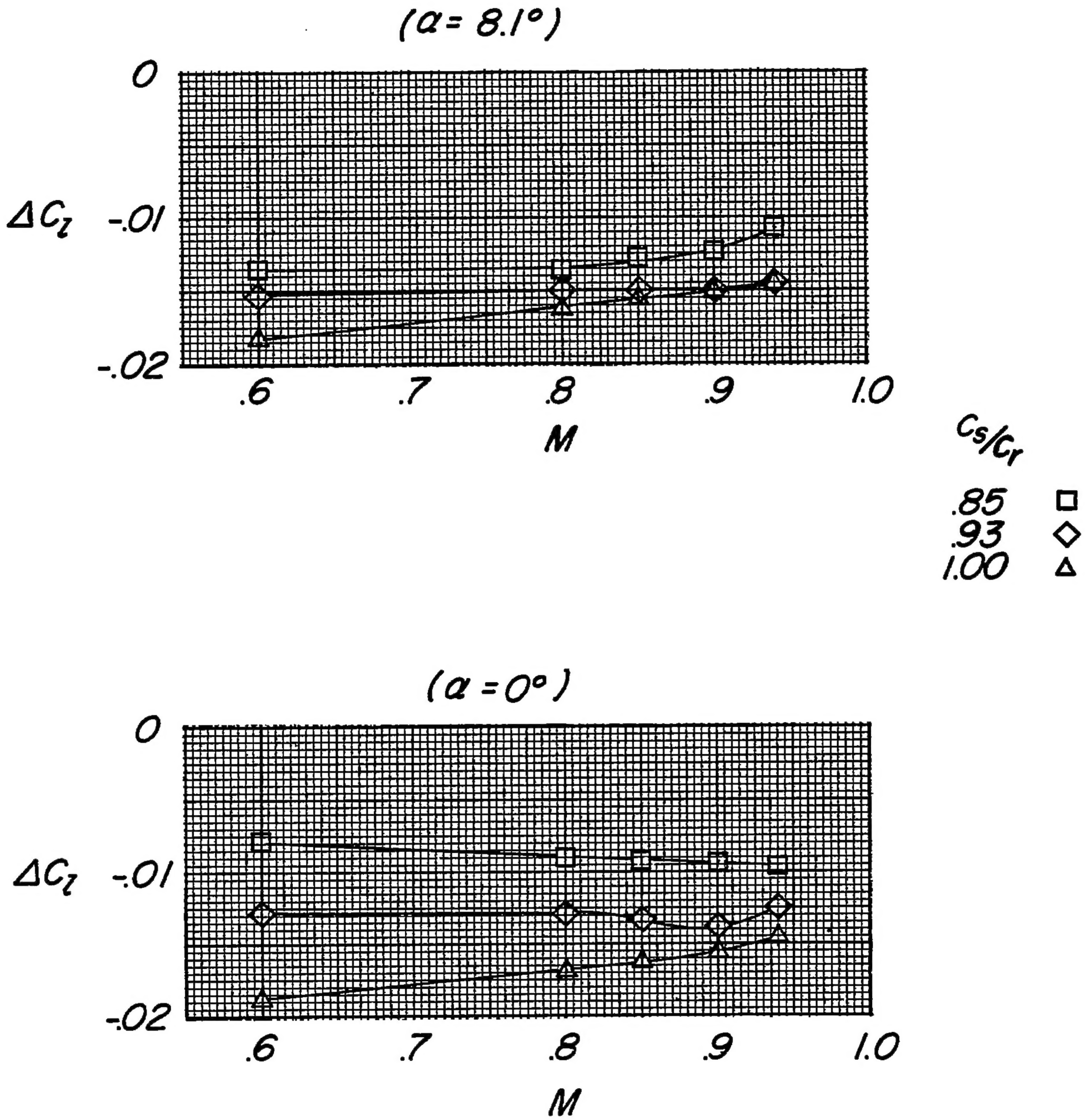


Figure 14.- Variation of incremental rolling-moment coefficient with Mach number for spoilers extending from the fuselage to $0.67\frac{b_l}{2}$ and located at several wing-chord stations. $\delta_s = -0.050\bar{c}$.